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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 146)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in February 1982 in

- Scientific and Technical Aerospace Reports (STAR)
- · International Aerospace Abstracts (IAA).



INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971.

This supplement to Aeronautical Engineering -- A Continuing Bibliography (NASA SP-7037) lists 442 reports, journal articles, and other documents originally announced in February 1982 in Scientific and Technical Aerospace Reports (STAR) or in International Aerospace Abstracts (IAA).

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries*, in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* and *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

Three indexes -- subject, personal author, and contract number -- are included. An annual cumulative index will be published.

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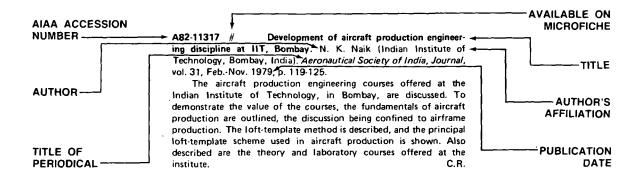
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TABLE OF CONTENTS

		Page
IAA ENTRIES (A82-1 Star Entries (N8	10000) 2-10000)	43 85
Personal Author Inc		B-1
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TYPICAL NASA SPONSORED	_ CITATION AND ABSTRACT FROM	STAR
DOCUMENT	N82-10021*# Kansas Univ. Center for Research, Inc., Lawrence.	AVAILABLE ON MICROFICHE
NASA ACCESSION NUMBER	Flight Research Lab. TCING TUNNEL TEST OF A GLYCOL-EXUDING POROUS LEADING EDGE ICE PROTECTION SYSTEM ON A GENERAL AVIATION AIRFOIL Final Report David L. Kohlman, William G. Schweikhard, and Alan E. Albright	CORPORATE
	Sep. 1981 → 37 p refs → (Grant NAG3-71) → (NASA-CR-165444; KU-FRL-464-1) Avail: NTIS ←	PUBLICATION
AUTHORS————	HC A03/MF A01 CSCL 01C ← Test results show that the system is very effective in preventing ice accretion (anti-ice mode) or removing ice from	DATE
CONTRACT OR GRANT	an airfoil. Minimum glycol flow rates required for antiicing are a function of velocity, liquid water content in the air, ambient temperature, and droplet size. Large ice caps were removed in only a few minutes using anti-ice flow rates, with the shed time being a function of the type of ice, size of the ice cap, angle of attack, and glycol flow rate. Wake surveys measurements	AVAILABILITY SOURCE
REPORT NUMBER	show that no significant drag penalty is associated with the installation or operation of the system tested.	

TYPICAL CITATION AND ABSTRACT FROM IAA



AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 146)

MARCH 1982

IAA ENTRIES

A82-12987 Creep and aero gas turbine design. R. E. Jenkins (Rolls-Royce, Ltd., Aero Div., Bristol, England). In: International Conference on Engineering Aspects of Creep, Sheffield, England, September 15-19, 1980, Proceedings. Volume 1.

London, Mechanical Engineering Publications, Ltd., 1980, p. 251-258.

Considerations given to creep in the design of aero gas turbines are reviewed. The basic requirements dictating the creep design of aero gas turbines are the attainment of the highest possible cycle temperature, consistent with the turbine cooling technology and the turbine life, and the maintenance of critical dimensions, such as clearance between rotating and static parts, throughout the service life. The importance of temperature assessment and definition and detailed analysis of typical flights is emphasized.

V.L.

A82-13016 ATARK laser tracking system. R. Grimes and D. Baxter (Contraves Goerz Corp., Pittsburgh, PA). In: Electro-optics/Laser 80 Conference and Exposition, Boston, MA, November 19-21, 1980, Proceedings. Chicago, Industrial and Scientific Conference Management, Inc., 1980, p. 255-267.

The Automatic Tracking and Ranging Kit (ATARK) is a modular pulsed laser transceiver and electronics system suitable for a wide range of instrumentation requirements found in current programs at test ranges. The primary criterion has been to provide a system with the highest single data point accuracy. Key features of the tracker are modular construction, with processor/software control, operation at 1.06 micron, dual lamp cavity, variable pulse rate, coaxial TV system for visual record/viewing, and linear tracking error over the field of view. Using retroreflectors, the ATARK system is operational to ranges in excess of 100,000 feet and provides range data of one foot with measured tracking error of 100 microradians accuracy.

A82-13020 Options for GTE precision automated tracking system. D. Stark (GTE Sylvania, Inc., Mountain View, CA). In: Electro-optics/Laser 80 Conference and Exposition, Boston, MA, November 19-21, 1980, Proceedings. Chicago, Industrial and Scientific Conference Management, Inc., 1980, p. 302-306.

The overall design and performance of the basic PATS (Precision Automated Tracking System) and recently incorporated new features are discussed. The target tracking subsystem of PATS is a 100 pulses-per-second, 15 ns pulse-width laser transmitter and optical receiver mounted on an elevation-over-azimuth tracking mount. A quadrant photodetector is used in conjunction with an amplitude monopulse receiver to develop boresight error data. These data drive the servo system which keeps the laser pointed at the target. The absolute accuracy in azimuth and elevation is better than 0.1 milliradians, the maximum dynamics is 2.0 rad/sec, with an acceleration of 500 milliradians/sq sec. The new features include dual mode capability and automatic camera focus.

A82-13077 * Darboux points in minimum-fuel aircraft landing problems. E. Kreindler and F. Neuman (NASA, Ames Research Center, Moffett ...Id, CA). In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings. Volume 1.

 $\begin{tabular}{lll} New York, & American & Institute & of & Chemical \\ Engineers, 1981, 5 p. (WA-1A). & 13 refs. \\ \end{tabular}$

An algorithm for suboptimal flight paths is used to show the existence of Darboux points on extremals of a fourth-order minimum-fuel horizontal aircraft landing problem; the states are two position coordinates, velocity and heading. It is shown that there is no simple relationship between Darboux points and conjugate points for a special second-order case of capturing a line at constant velocity.

B.J.

A82-13078 Fuel efficient flight profiles in an ATC flow management environment. R. W. Schwab (Boeing Commercial Airplane Co., Seattle, WA). In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings. Volume 1. New York, American Institute of Chemical Engineers, 1981, 6 p. (WA-1B).

The Flow Management research program was established to define the airborne navigation/guidance capabilities needed for efficient operation in the ATC Flow Management system under development; the Flow Management research is one element of the NASA Terminal Configured Vehicle program. This paper examines the Flow Management algorithms, and reviews in-plane geometry and ATC constraints, wind and temperature modeling, descent initialization, runway profile descent calculation, aeroperformance envelope determination, high profile descent calculation, and holding and path stretching.

A82-13079 * A decoupled control system for improved flight performance in wind shear. G. K. Miller, Jr. (NASA, Langley Research Center, Hampton, VA). In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings. Volume 1. New York, American Institute of Chemical Engineers, 1981. 9 p. (WA-1D). 9 refs.

A fixed-base simulation study has been made to compare the approach and landing performance of a decoupled longitudinal control system and the velocity-vector control-wheel steering (VCWS) system that currently exists on the NASA Terminal Configured Vehicle (TCV). The decoupled control system employed constant prefilter and feedback gains to provide steady-state decoupling of flight-path angle, pitch angle, and forward velocity using symmetric spoilers, throttle, and elevator as active control elements. In severe wind shear, of the Kennedy-type, the decoupled control system improved both approach performance and touchdown performance even when the spoiler deflection was limited to 16 deg. On a 10-point rating scale, three research pilots rated the approach and landing task with decoupled controls as much as 3 to 4 increments better than the use of the VCWS system in severe winds. (Author)

A82-13088 A dual input actuator for fluidic backup flight control. M. F. Cycon, Jr. (Garrett Corp., Pneumatic Systems Div., Phoenix, AZ). In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings. Volume 1.

New York, American Institute of Chemical Engineers, 1981. 8 p. (WA-8B). 5 refs.

This paper describes the application of pneumatic fluidics to obtain closed-loop position control of a high-pressure, direct-drive, electrohydraulic actuator. The fluidic control, which requires no electrical power, is a backup to the primary electronic control. Tests conducted using a prototype fluidic circuit demonstrate the feasibility of a dual input (electronic-fluidic) actuator using technologically dissimilar redundant control methods. (Author)

A82-13093 Digital redesign of existing multiloop continuous control systems. K. S. Rattan (Wright State University, Dayton, OH). In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings. Volume 1.

New York, American Institute of Chemical Engineers, 1981. 8 p. (WP-1D). 9 refs. Contract No. F49620-79-C-0038.

A computer-aided method for converting existing multiloop continuous-data control systems into digital control systems is presented. Digital controllers are synthesized by matching the frequency responses of the digital control system to that of the continuous control system with a minimum weighted mean square error. Formulas for computing the parameters of the digital controllers are obtained as a result. An example of digitalizing existing continuous flight controller for the longitudinal YF-16 aircraft is considered and the results obtained are compared with those obtained by the Tustin transform. (Author)

A82-13094 Digital control for flexible aircraft using reduced order models. G. L. Slater and R. Kandadai (Cincinnati, University, Cincinnati, OH). In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings. Volume 1.

New York, American Institute of Chemical Engineers, 1981, 6 p. (WP-1E), 9 refs.

A control synthesis is presented for a very flexible aircraft, and the effects on performance from different types of suboptimal approximations are compared. By examining the response at varying sample rates, it is shown that there is a tradeoff between model accuracy and computational feasibility. When the computational requirements of higher-order models are considered, the slow sample rates imposed by these requirements make the reduced order model a superior controller.

B.J.

A82-13106 Comparison between the exact and an approximate feedback solution for medium range interception problems. J. Shinar (Technion - Israel Institute of Technology, Haifa, Israel), K. H. Well, E. Berger (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für dynamik der Flugsysteme, Oberpfaffenhofen, West Germany), and M. Negrin. In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings. Volume 1. New York, American Institute of Chemical Engineers, 1981, 6 p. (TA-1A). 14 refs.

The forced singular perturbation technique (FSPT) is compared with a multiple shooting algorithm known for its high precision. Three-dimensional medium range air-to-air interception is formulated as a minimum-time control problem, and the formal optimal solution is outlined. The FSPT model of the original problem is introduced, and the zero-order composite feedback solution is presented. Results of the comparison for a characteristic example are discussed, and the comparison of the zero-order FSPT feedback approximation to the precise MSA solution was found to be very encouraging.

A82-13107 * On-line optimization of aircraft altitude and flight path angle dynamics. A. J. Calise (Drexel University, Philadelphia, PA). In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings, Volume 1.

New York, American Institute of Chemical Engineers, 1981. 6 p. (TA-1B). 5 refs. Grant No. NsG-1496.

The optimization of aircraft altitude and flight path angle dynamics is addressed in a form suitable for on-line computation and control. The approach here is a direct extension of the work reported by Calise (1979), where singular perturbation methods were used to optimize position, energy and heading dynamics; it thus represents an optimal control solution that models all of the primary trajectory related dynamics. It is pointed out that the resulting algorithm can be regarded as a nonlinear feedback control law. The minimum time intercept of a fixed terminal point is used in setting the framework in which the analytical results are developed. The main theoretical result is that the dynamics, while not completely separable, can be approximated by singular perturbation methods when the control model includes relative position dynamics.

C.R.

A82-13115 * Air-to-air combat analysis - Review of differential-gaming approaches. M. D. Ardema (NASA, Ames Research Center, Moffett Field, CA). In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings.

Volume 2. New York, American Institute of Chemical Engineers, 1981. 9 p. (TP-1B). 15 refs.

The problem of evaluating the combat performance of fighter/ attack aircraft is discussed, and the mathematical nature of the problem is examined. The following approaches to air combat analysis are reviewed: (1) differential-turning differential game and (2) coplanar differential game. Selected numerical examples of these approaches are presented. The relative advantages and disadvantages of each are analyzed, and it is concluded that air combat analysis is an extremely difficult mathematical problem and that no one method of approach is best for all purposes. The paper concludes with a discussion of how the two approaches might be used in a complementary manner. (Author)

A82-13119 * On matching the systems identification technique to the particular application. W. T. Suit and M. H. Mayo (NASA, Langley Research Center, Hampton, VA). In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings. Volume 2. New York, American Institute of Chemical Engineers, 1981, 8 p. (TP-4C). 21 refs.

Several maximum likelihood and multiple regression parameter estimation programs are currently being used at the Langley Research Center of the NASA to analyze aircraft flight test data. Based on this wealth of experience, the pertinent features of these programs are investigated and some of the difficulties involved in their use are discussed. By comparing computational time, data requirements and accuracy needed, a strategy for determining which program can be used to the best advantage of the flight test engineer is discussed. (Author)

A82-13120 Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes. G. D. Park and M. H. Abla (Gates Learjet Corp., Wichita, KS), In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings. Volume 2. New York, American Institute of Chemical Engineers, 1981. 6 p. (TP-4D). 8 refs.

Gates Learjet Corporation has utilized parameter identification techniques on flight test data in various ways to substantiate the airloads analyses used in certifying its airplanes. These analyses have concentrated primarily on the empennage and include: horizontal stabilizer rolling moment; vertical tail side load; horizontal tail actuator load; elevator, rudder and aileron pilot forces; and elevator hinge moment. Using the appropriate empennage loads results in conjunction with the results obtained from the total airplane responses, the component (wing-body, vertical tail, horizontal) airplane parameters were determined. The Taylor-Iliff computer program from NASA has been shown to be a very effective and efficient technique to substantiate airload analyses. (Author)

A82-13122 Wing/store flutter - An active adaptive control application, C. A. Harvey (Honeywell Systems and Research Center, Minneapolis, MN). In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings. Volume 2.

New York, American Institute of Chemical Engineers, 1981. 3 p. (FA-1A). 9 refs. Research supported by Honeywell, Inc., Contracts No. F33615-77-C-3096; No. F33615-80-C-3217.

The paper briefly summarizes the results of a recent feasibility study and progress on a wind tunnel demonstration of digital adaptive control of wing/store flutter with regard to modern fighter aircraft. The design features of such a controller are examined, including sensor selection for feedback, detection, and discrimination, and two adaptive approaches, maximum likelihood estimation and self-tuning regulation.

A82-13125 * The design of exact nonlinear model followers.
G. Meyer (NASA, Ames Research Center, Moffett Field, CA). In:
Joint Automatic Control Conference, Charlottesville, VA, June
17-19, 1981, Proceedings. Volume 2. New York,
American Institute of Chemical Engineers, 1981. 7 p. (FA-3A). 16

A practical approach to the design of control systems for strongly nonlinear, multivariable, time-dependent plants is described. The structure of the control system is that of an exact model follower. The model dynamics are decoupled, linear, constant, and of the order of the plant. The plant state and controls are transformed

so that the plant, when viewed through these transformations, looks like the simple model. Regulation of disturbances is accomplished by means of the transformed state and controls. Conditions for transformability into linear models, the appropriate models, and the construction of the transformations are discussed. The approach is illustrated on a trajectory autopilot for a helicopter. (Author)

A82-13128 An approach to robust nonlinear control design. M. K. Sain (Notre Dame, University, Notre Dame, IN) and J. L. Peczkowski (Bendix Corp., Energy Controls Div., South Bend, IN). In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings. Volume 2. New York, American Institute of Chemical Engineers, 1981. 6 p. (FA-3D). 18 refs.

The paper examines a control philosophy that linearizes the simulation at a finite number of points over the envelope of operation, that applies linear design technique locally about each such point, and that strings all the local designs together into a global design by scheduling the resulting compensations over the envelope as a function of key physical variables, and within a broad nonlinear model following strategy. Attention is given to the relevant local model following ideas, an extension of the local comparison sensitivity concept to the model following situation, and the global model following concept. A complete illustration based on a realistic nonlinear turbojet engine simulation is presented.

B.J.

A82-13142 Fault detection for two physically separated, communicating inertial measurement units. P. Motyka (Charles Stark Draper Laboratory, Inc., Cambridge, MA). In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings. Volume 2. New York, American Institute of Chemical Engineers, 1981. 10 p. (FP-2B) 6 refs. Contract No. F33615-78-C-1563.

The paper develops an analytic technique for the generation of failure detection and isolation (FDI) thresholds for a tactical aircraft system with two separated IMUs. The basic problem is to select thresholds which result in the detection and isolation of failures ranging from hard (those which affect flight-control performance) through midvalue (which affect pilot display performance) and soft (which affect navigation and weapon-delivery performance). FDI is accomplished by means of the generalized likelihood test. Results are presented which show the operation of the FDI system over a realistic flight profile, which incorporates maneuvers typical of a fighter aircraft mission.

A82-13150 # Aeronautics in China - An AIAA report. J. Grey. New York, American Institute of Aeronautics and Astronautics (AIAA Aerospace Assessment Series. Volume 4), 1981. 201 p. Members. \$20.; nonmembers. \$24.

Following the normalization of relations between China and the U.S., it was agreed that the Chinese Society of Aeronautics and Astronautics and the American Institute of Aeronautics and Astronautics would undertake an exchange of scientists and engineers to initiate the process of technical communication between the two nations in the field of aeronautics. This book reports the observations of the AIAA delegation which visited various aeronautical facilities in China. The history of Chinese aeronautics is considered along with aspects of aircraft production, engine production, and aerodynamics research, development, and testing. Attention is given to materials and structures, flight testing, guidance and control, computers, university educational programs, special topics, and aspects of travelling in China.

A82-13237 The Agusta A129. B. Lovera (Costruzioni Aeronautiche Giovanni Agusta S.p.A., Gallarate, Italy). *Vertiflite*, vol. 26, Nov.-Dec. 1980, p. 6-9.

The design characteristics, performance capabilities and electronics systems of the A-129 light combat helicopter currently under development for Italian Army use are discussed. Attention is given to the aircraft's Integrated Multiplex System (IMS), whose functions fall into four categories: (1) the optimized interconnection of radios and navigation equipment; (2) the management of electrical power distribution, powerplant monitoring and control, and caution and warning; (3) the integration of motion sensors, digital stability

augmentation systems, and flight director function; and (4) the operation of cockpit control and display elements, including flight management and radio control. The twin-turboshaft helicopter is primarily armed for the antitank role, with the TOW missile system mounted on stub wing pylons. Attention is also given to the airframe, mission equipment, and configuration flexibility of the aircraft.

O.C.

A82-13238 Public service helicopters - Is the grass greener on the other side of the fence. T. R. Stuelpnagel. *Vertiflite*, vol. 26, Nov.-Dec. 1980, p. 10-13.

The impact on helicopter design of public service helicopter users, concerned with such tasks as law enforcement and public safety, search and rescue, wildlife and land management, fire fighting, medical services and disaster relief, is assessed in view of the present and growth markets they represent. New public service helicopter sales are estimated to be 5-10% of total commercial sales. It is recommended that public service helicopter users review their experience with each helicopter type employed and make their evaluations and requirements known to both the government and helicopter manufacturers on an annual basis. An awareness of helicopter equipment and configuration development would also be helpful, in order to propose the incorporation of features relevant to public service missions during the design phase of new helicopters, whose development cost is now on the order of \$10,000 per pound of gross weight.

A82-13239 The TADS/PNVS 'eyes' for the AH-64 attack helicopter. B. J. Baskett, C. M. Tsoubanos, and V. M. Welner (U.S. Army, Aviation Research and Development Command, St. Louis, MO). Vertiflite, vol. 26, Nov.-Dec. 1980, p. 14-17.

The Target Acquisition Designation Sight (TADS)/Pilot Night Vision Sensor (PNVS) electrooptical subsystem of the AH-64 advanced attack helicopter is described, with attention to its Integrated Helmet and Display Sight System (IHADSS). The TADS provides the helicopter copilot/gunner with day, night, and adverse weather target search, detection and recognition capabilities by means of (1) direct view optics (DVO), (2) day television (DTV), and (3) forward looking infrared (FLIR) sighting subsystems, each subsystem being used singly or in combination depending on tactical, weather, or visibility conditions. The TADS also provides a laser designator to illuminate the target and guide HELLFIRE missiles, and a laser receiver which provides target range measurements for fire control computations. Samples of typical PNVS symbology, including heading, power management, airspeed, and radar altitude, are also O.C. aiven.

A82-13240 Fatigue methodology - A technical management system for helicopter safety and durability. L. L. Douglas. Vertiflite, vol. 27, Mar.-Apr. 1981, p. 14-17.

An account is given of the development since the early 19th century, of the technical disciplines comprising the field of fatigue-related structural safety as it applies to the design and maintenance of helicopters. Attention is given such milestones in the development of analytical methods for rotating machinery and vibration and flutter problems as N.O. Myklestad's (1944) 'A New Method of Calculating Natural Modes of Uncoupled Bending Vibration of Wings and other Types of Beams', as well as the related topics of the fatigue strength of materials and its improvement by surface treatment, stress concentration, cumulative damage and fatigue crack propagation. A review is also made of more recent developments in the design of fail-safe structures, the production of fracture-tough steel, aluminum and titanium alloys, and the application of composite materials to helicopter rotor blades.

A82-13241 Heavy lift helicopters - A national technology opportunity. G. H. Fries (Boeing Vertol Co., Philadelphia, PA). Vertiflite, vol. 27, May-June 1981, p. 14-17.

The mission requirements and possible design features of future heavy lift helicopters (HLH) in the 120,000 to 150,000-lb gross weight category are described. Attention is given to the military need for such helicopters in view of the U.S. Army's cancellation of the XCH-62 HLH project and the Soviet Union's reported development of the NATO code-named 'Halo' HLH, which has a lift capacity greater than that of any U.S. cargo helicopter. Consideration is given

to the relative advantages of the military, 'crane' configuration and those of a full-fuselage transport design with lower aerodynamic drag and greater productivity in longer-range missions. The transport fuselage configuration is also suited for short-haul commercial passenger service, with 140-150 seats initially and 225 seats in subsequent growth versions. Development-program cooperation between the Department of Defense and NASA is recommended. O.C.

A82-13242 The FAA's proposed helicopter certification rules. R. G. Schlegel (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). Vertiflite, vol. 27, May-June 1981, p. 18-21.

A response is presented by the helicopter manufacturing industry to the FAA's Notice of Proposed Rule Making NPRM 79-13, 'Noise Standards for Helicopters in the Normal, Transport, and Restricted Categories'. Among the grounds cited for rejection are: (1) the proposed regulation sets limits that are too low, and incompatible with, the capabilities of existing technology for predicting and controlling helicopter noise; (2) regulation is premature at this time, because uncertainty as to the actual noise of the helicopters affected prevents a complete analysis of the regulation's economic impact; and (3) a loss of \$8 billion in sales of current helicopter models could result from implementation of NPRM 79-13, with an additional \$4.8 billion sales loss due to delays in the introduction of new helicopter designs. A joint industry/government program to establish the noise levels of all helicopters affected by the regulation is recommended.

A82-13243 Helicopter icing. A. A. Peterson and L. U. Dadone (Boeing Vertol Co., Philadelphia, PA). *Vertiflite*, vol. 27, May-June 1981, p. 22-25.

Due to the increased Instrument Flight Rules (IFR) capabilities of modern helicopters and the associated need for all-weather clearance, the U.S. Department and Defense and FAA are emphasizing helicopter icing investigations. Of all existing helicopters, only the Bell 412 is undergoing icing certification tests, and the SA 330 PUMA alone has obtained unlimited clearance for flight in forecast icing conditions. Consideration is given to the simulation of natural icing conditions by means of (1) icing wind tunnels; (2) environmental cold chambers; (3) helicopter tie-down sites that employ natural icing; (4) hover spray rigs; and (5) in-flight spray systems. Attention is also given to rotor ice protection systems, including those that employ high-resistance electrical heating elements, inflatable boots, microwave energy, controlled vibration, and such chemical freezing point depressants as glycol.

A82-13244 Light Airborne Multi-Purpose System. J. M. Purtell (U.S. Navy, Washington, DC). *Vertiflite*, vol. 27, Sept.-Oct. 1981, p. 10-13.

The Light Airborne Multi-Purpose System (LAMPS) MK III is the U.S. Navy's first fully integrated ship/air weapons system, combining frigates, destroyers and cruisers as platforms with Seahawk missile-carrying helicopters for the basic ASW mission. The helicopters also provide targeting data for Harpoon surface-to-surface missiles. The LAMPS ship/air system, which will involve over 100 ships and 204 aircraft over the next 25 years, will overcome four traditional weaknesses: (1) radar horizon limits, (2) sonar discrimination limits at extended ranges, (3) the range limitations of ASW weapons, and (4) limited missile-targeting ranges. Other elements comprised by the system are secure and open HF and UHF voice channels system management and control signal processors for the analysis of tactical data, and helicopter-delivered MK-46 ASW torpedoes.

A82-13245 Helicopter IFR - Past, present and future and future. V. E. Albert (Petroleum Helicopters, Inc., New Orleans, LA). Vertiflite, vol. 27, Sept.-Oct. 1981, p. 18-20.

An account is given of the developmental history and future prospects of helicopter Instrument Flight Rules (IFR) regulatory policies, flight instruments and procedures. The development of helicopter IFR has been speeded by British North Sea offshore oil drilling operations, whose helicopter service regularly encounters severe flying conditions. Among the problems encountered in the establishment of helicopter IFR in the U.S. have been the development of route structures to support such flights in the Northeast Corridor and Gulf Coast regions, the complexity of telephone and

radio relay communications with air traffic controllers, and the establishment of weather stations. At present, in addition to the installation of offshore VHF radio stations in the Gulf of Mexico, a weather observation network and a route structure have been provided. The Loran Flight Following Program being tested at Houston station will provide remote areas with traffic separation services currently available only in urban areas, while costing only as much as two VHF remote radio locations.

O.C.

A82-13246 Wire strike protection. C. Silvious (Tennessee Valley Authority, Knoxville, TN). Vertiflite, vol. 27, Nov.-Dec. 1981, p. 16-19.

Consideration is given to the design requirements of, and experience to date with, helicopter wire-strike protection devices made necessary by low-altitude operations in areas with extensive electrical transmission and communication lines. The tensile strengths of electrical transmission wires varies between 5000 and 233,000 lb, averaging 27,000 lb, and may become entangled in rotating parts even if successfully broken or cut by a helicopter. In addition to the education of pilots to better recognize wire strike hazards, attention is given to the use of wire-marking devices, which are useful in daytime operations, and the design of tail-rotor, main rotor and fuselage devices for cutting through or shielding against wires. It is recommended that all three measures be taken in future strike-reduction efforts by utilities and other helicopter operators.

A82-13314 Costs of noise nuisance from aircraft, P. W. Abelson (McQuarie University, North Ryde, New South Wales, Australia). *International Journal of Environmental Studies*, vol. 17, no. 3-4, 1981, p. 225-232. 10 refs.

The paper summarizes the results of research into aircraft noise costs around Sydney airport. The NEF (noise exposure forecast) model of noise annoyance is shown to provide a fair index of average, but not individual, attitudes toward noise. Although property prices were found to fall only by an average of 0.4% NEF, the fall per NEF is greater for higher values of NEF and for higher income households. However, household turnover rates due to noise, and therefore the costs of moving house, were found to be higher than those predicted by the Roskill Commission for the expected third London airport. Also, householders in noisy areas experience substantial losses in householder surplus, due in part to imperfect expectations of the noise effects. (Author)

A82-13451 Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. Conference sponsored by the American Institute of Aeronautics and Astronautics and Institute of Electrical and Electronics Engineers. New York, American Institute of Aeronautics and Astronautics, 1981. 645 p. Members, \$65.; nonmembers, \$75.

Digital avionics are discussed in terms of a system integration concept, fault isolation methodology, system effectiveness, advanced designs, sneak software analysis, and the pilot's role in an automated flight deck. Specific applications for the L-1011 flight control system, for hardware/software integration on the Shuttle, for one man operation of the F/A-18 Hornet, with voice command control, and for advanced weapons systems were considered. Papers were also presented on individual components of digital avionics systems such as the MIL-STD-1750 chip set, standardization and semiconductors, fiber optics, connectors for data buses, large screen CRT touch panels, an electronic terrain map, and flat panels for future military aircraft.

D.H.K.

A82-13452 # Integrated avionics - Concepts and concerns.
D. G. Botha (USAF, Avionics Laboratory, Wright-Patterson AFB, OH). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 1-9. 14 refs. (AIAA 81-2211)

It is noted that the capability of avionics technology continues to increase by an order of magnitude every few years, but overall avionic system design architecture lags in the ability to fully exploit new technology and knowledge, particularly in the partitioning of the avionics-as-a-whole into subsystems for implementation by engineers in many disciplines, and in the integration of subsystems

into the whole. In this paper, it is suggested that a concerted effort is needed by the avionics community to reexamine system partitioning, considering the relationship of subsystems in the light of new operational concepts, new knowledge in information and control theory, and different concepts of integration such as multisensor information fusion and integrated control and display interface with the crew.

B.J.

A82-13453 # F/A-18A weapon system - 1976 state of the art. R. C. Drummond (McDonnell Aircraft Co., St. Louis, MO). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 10-20. (AIAA 81-2215)

The F/A-18A system will perform both air/air and air/surface missions and has been designed for low operating and support costs through excellent reliability and maintainability. Advanced technologies include a one-man operable cockpit, using multifunction programmable CRTs and an automated hands-on-throttle-and-stick concept. Also included are a highly flexible radar using advanced digital processing and memory techniques, a programmable stores management set with multiplexed store stations, a quad-redundant electronic flight control system, and an expanded built-in-test capability. The design and performance features of the F/A-18A system are examined, and the future outlook is discussed.

A82-13455 # Digital avionics - What a pilot expects to see. R. A. Berube (Pan American World Airways, Inc., Miami, FL). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 28-38. 57 refs. (AIAA 81-2217)

The application of digital computers to aircraft is discussed from the pilot's point of view. Consideration is given to future digital design, human factors, cockpit instrumentation and predictive information, replication of the visual scene, display types, and performance/flight management systems. Particular attention is given to the importance of cockpit displayed traffic information. B.J.

A82-13456 # Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond. J. H. Shannon and J. D. McDonnell (Douglas Aircraft Co., Long Beach, CA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 39-46. (AIAA 81-2218)

The airlines' decade of experience with digital airborne equipment is reviewed, and some of the benefits arising from active controls, advanced cockpits, and advanced ATC systems that will be incorporated in the 1980's are described. This experience has given the airlines and manufacturers the confidence to further implement avionics systems with digital technology. The DC-9 Super 80 is now in revenue service with a digital flight guidance system, and other aircraft will soon enter service with the new ARINC 700 line of equipment. Additional benefits will be gained in the second half of the 1980's owing to both the cost-effective character of the equipment itself and the increase in efficiency of airframes and propulsion systems that can be obtained through further application of the digital equipment.

A82-13457 # The role of avionics in the all electric airplane. M. J. Cronin (Lockheed-California Co., Burbank, CA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 47-55. 22 refs. (AIAA 81-2219)

The paper examines the role of avionics in the development of the all-electric airplane (AEP) as a viable and energy-efficient transport. It is noted that avionics will play a key role in the fuel and thrust management of the advanced-technology engines of the AEP via technology such as FADEC (full authority digital engine control). Attention is also given to the important role of avionics in the flight control of future AEPs, operating with a relaxed static stability and advanced supercritical wings. The samarium-cobalt motor/generator

development and the proliferating use of power electronics for engine starting/motor control are also discussed.

B.J.

A82-13458 # Fault isolation methodology for the L-1011 digital avionic flight control system. W. B. Noble (Rockwell International Corp., Collins Air Transport Div., Van Nuys, CA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 56-61. (AIAA 81-2223)

The operation of and rationale for the fault isolation/data display system for the L-1011 digital avionic flight control system are described. These systems are currently in service and are, despite the usual and expected introductory problems, providing substantial maintenance benefit. The English-language format chosen for the display as well as the storing of the squawk (or event) which accompanied each fault, have been instrumental in reducing maintenance confusion and false LRU removals. Present status mode is being used to solve a number of intricate maintenance problems in minutes, which previously required hours of troubleshooting time.

B.J.

A82-13463 # Avionics implications from weapon system operational utility studies on Manned Air Combat Simulators. N. J. Kessler and H. Passmore (McDonnell Aircraft Co., St. Louis, MO). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 85-92. (AIAA 81-2230)

The McDonnell Aircraft Company Manned Air Combat Simulator (MACS) is described. The simulator facility is discussed, and a definition of the test models is given. In addition, attention is given to the lessons learned and system modifications which evolved as a result of this type of testing. It is noted that the value of MACS has recently been demonstrated as a tool for the evaluation in a simulated combat environment of the operational utility of such systems as the Advanced Medium Range Air-to-Air Missile (AMRAAM).

A82-13465 # Computer-in-control selection logic for a triplex digital flight control system. P. J. Ferrell (Boeing Military Airplane Co., Seattle, WA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 97-101. (AIAA 81-2236)

The computer-in-control logic (CICL) unit is an independent monitor that ensures proper selection of one of two flight control computers to the simplex level with minimum switching. The CICL maximizes fault tolerance without being a source of a single-point failure; its implementation is simple and reliable, and its algorithm is easy to change. This paper presents a functional description of the CICL and examines potential architectural considerations.

B.J.

A82-13466 * # Application of the concept of dynamic trim control and nonlinear system inverses to automatic control of a vertical attitude takeoff and landing aircraft. G. A. Smith and G. Meyer (NASA, Ames Research Center, Moffett Field, CA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 102-115. 8 refs. (AIAA 81-2238)

A full envelope automatic flight control system based on nonlinear inverse systems concepts has been applied to a vertical attitude takeoff and landing (VATOL) fighter aircraft. A new method for using an airborne digital aircraft model to perform the inversion of a nonlinear aircraft model is presented together with the results of a simulation study of the nonlinear inverse system concept for the vertical-attitude hover mode. The system response to maneuver commands in the vertical attitude was found to be excellent; and recovery from large initial offsets and large disturbances was found to be very satisfactory.

B.J.

A82-13467 # Aircraft separation assurance avionics. R. Sobocinski (Bell Aerospace Textron, Belmont, CA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19.

1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 116-118, (AIAA 81-2239)

Avionics sensors are under development to detect other transponder equipped aircraft. These sensors are subsets of systems postulated for the next generation aircraft. An Active BCAS system sponsored by the FAA interrogates, tracks and provides vertical collision avoidance commands. A Cockpit Display of Traffic Information (CDTI) sensor under NASA sponsorship passively detects transponder replies to ground based SSR sites. The CDTI provides a horizontal situation traffic display. This unit is being evaluated for pilot human factors interface. (Author)

A82-13468 # Aircraft alerting systems standardization study. G. P. Boucek, Jr., D. C. Hanson (Boeing Commercial Airplane Co., Seattle, WA), D. A. Po-Chedley (Douglas Aircraft Co., Long Beach, CA), B. L. Berson, M. F. Leffler (Lockheed-California Co., Burbank, CA), and J. F. Hendrickson (FAA, Washington, DC). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 119-128. 10 refs. FAA-supported research. (AIAA 81-2242)

The objectives of the Aircraft Alerting Systems Standardization Study were to augment the existing alerting system data base, to develop candidate alerting system concepts, to implement and validate these concepts, and to develop a set of alerting system guidelines and recommendations to standardize alerts on future electronic flight decks. This paper examines some of the more salient of these system guidelines and recommendations, which include: (1) that a functionally standardized alerting system be used on all future transport aircraft regardless of manufacturer, aircraft type, or airline operator; (2) that pilots audio/visual environment be improved by minimizing exposure to unnecessary or confusing alerts; (3) that three distinctively coded alert categories be provided to reduce uncertainty; and (4) that use be made of both visual and auditory channels to increase system effectiveness.

B.J.

A82-13470 # Design and analysis of a digitally controlled integrated flight/fire control system. J. H. Blakelock (Applications Research Corp., Dayton, OH). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 135-143, 7 refs. Contract No. F33615-78-C-3145. (AIAA 81-2245)

An integrated flight/fire control system including a movable gun and gimbaled line-of-sight tracker was designed using root locus techniques for the inner analog control loops and discrete analysis of the sampled-data outer control loops. The control systems designed include a pitch orientational control system with an outer attitude control loop, a beta/first time derivative of beta lateral stability augmentation system (where beta is the sideslip angle) with command yaw rate and a roll angle control system with an outer yaw attitude control loop, a velocity control system, a control loop for the movable gun, and the tracking control system. The discrete analysis was performed in the z-plane using traditional methods and in the s-plane using the Padé approximation. The gains for neutral stability and corresponding system natural frequencies predicted by both analysis techniques showed excellent correlation with the value obtained from a detailed six-degree-of-freedom hybrid simulation of the aircraft and various control systems.

A82-13471 # Joint Tactical Microwave Landing System /JTMLS/ airborne signal processing. R. J. Kelly and J. T. Skudrna (Bendix Corp., Communications Div., Baltimore, MD). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 144-155. 7 refs. (AIAA 81-2247)

The Joint Tactical Microwave Landing System, a lightweight transportable landing system which will provide all-weather precision approach guidance to drop zones, landing zones, and runways for MLS-equipped CTOL, STOL, VTOL, and rotary wing aircraft, is described with emphasis on the airborne avionics. It is shown how the airborne angle receiver satisfies the operational requirements by using an integrated digital avionics design and associated airframe antennas. This integrated avionics system will detect the MLS signal

over a wide range of aircraft attitudes and will provide signal processing to generate lateral, vertical, and longitudinal guidance information for the complete spectrum of military FCS and cockpit displays.

V.L.

A82-13472 # LHX - An advanced avionics system design. D. S. D'Avino (SEMCOR, Inc., Neptune, NJ) and S. S. Spiegel (SEMCOR, Inc., Moorestown, NJ). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 156-162. (AIAA 81-2249)

The paper reports results of a study which was performed with the objective of developing an avionics system concept for the LHX, an advanced Army weapons system. The preliminary results indicate that all currently defined LHX requirements for the armed scout mission are achievable using advanced technology and innovative system integration techniques. It is also shown that a one-man crew for the LHX is technically feasible.

V.L.

A82-13481 * # Have we overlooked the pilot's role in an automated flight deck. G. G. Steinmetz, L. H. Person, and S. A. Morello (NASA, Langley Research Center, Hampton, VA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 222-227. 22 refs. (AIAA 81-2262)

Having adopted a philosophy of presenting situation information rather than command type as evidenced in flight directors and of keeping the pilot in a decision-making role, a series of simulation and flight experiments has occurred over a number of years as part of the Langley Terminal Configured Vehicle program. This paper traces the development, refinement, and integration of electronic pictorial displays, and a computer augmented velocity vector control mode. Some benefits and performances derived within the basic philosophy and information usage are brought forth in the discussion as results from the various simulator and flight evaluations are presented.

(Author)

A82-13482 # The application of large screen CRT's, touch panels, and voice to the flight stations of the 1990's. R. L. Wasson and H. S. Archer, III (Lockheed-Georgia Co., Marietta, GA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 228-236. 5 refs. (AIAA 81-2263)

The paper examines how advances in technology, such as large screen displays, touch panels, and voice control affect the design of Lockheed's 1990's flight station. An integrated design embodying these concepts is presented and the advantages of such a design is explored. The paper is divided into two sections, the first addresses the inclusion of the advanced technology in the overall design of the flight station, and specific large screen display formatting, the second discusses the display/control technology necessary to implement such a design. (Author)

A82-13483 # Electronic flight deck displays for transport aircraft. R. A. Chorley (Smiths Industries Aerospace and Defence Systems Co., Cheltenham, Glos., England). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 237-246. 5 refs. Research supported by the Department of Industry and Ministry of Defence (Procurement Executive). (AIAA 81-2264)

Electronic flight deck and systems information displays for transport aircraft are discussed. Operational and economic advantages for military and civilian aircraft are reviewed, such as the flexibility of the display format which enables all information required for control of a transport aircraft to be displayed on the main panel, and the flexibility of the electronic system which minimizes the effects of failure within the display system. The display system configuration and the units of the electronic display system are presented, and human factors are considered.

D.L.G.

A82-13484 # F/A-18 'Hornet' - One man operability. E. C. Adam (McDonnell Aircraft Co., St. Louis, MO). In: Digital Avionics

Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 247-251. (AIAA 81-2266)

Features of the F/A-18 fighter avionics design which allow one man operation in both fighter and attack modes are described. A CRT, along with head-up displays, provide the pilot with information essential for air-to-air, air-to-surface, and navigation modes. Pilot scan times are reduced because of information grouping and mission reliability is enhanced because of redundant image projection capabilities. The hands on throttle and stick system has an automated LOCK light for weapons delivery in a completely head-up, sensor-aided gun or missile attack. Console activity has been minimized through automation of time critical tasks, thus reducing the chances for pilot error or vertigo. A 98% failure detection and 99% failure isolation is built into the weapon system maintenance monitor panel. Operational capability is scheduled for 1983. M.S.K.

A82-13485 # ARINC 429 digital data communications on the Boeing 757 and 767 commercial airliners. R. K. Chun (Boeing Aerospace Co., Seattle, WA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 252-256. 5 refs. (AIAA 81-2267)

This paper will address the development and applications of the ARINC 429 digital data bus on the new generation of Boeing 757 and 767 commercial aircraft. The ARINC 429 Digital Information Transfer System (DITS) broadly defines a new digital data transmission format for avionics subsystems used in the next generation of commercial aircraft avionics applications. Boeing's development of a transmitter and receiver hybrid circuit which is compatible with ARINC 429 at the data bus interface will also be discussed. The hybrid package is hermetically sealed and designed to comply with the full range of military temperature requirements. (Author)

A82-13487 # A polled contention multiplex system using MIL-STD-1553 protocol. D. H. Wilson (Vought Corp., Dallas, TX). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 264-270, (AIAA 81-2271)

The polled contention mode in the Avionic Multiplex System is discussed, and a technique to pass the bus controller function between the terminals based on the activity of input data is presented. Improvements such as decreased data latency, more efficient bus utilization, and simplicity in software implementation are reviewed, and associated problems are considered. It is concluded that the use of dynamic bus allocation will have increasing significance as future systems become larger and more complex, while the polled contention mode may be a viable alternative to the command response system.

D.L.G.

A82-13488 # Avionics systems simulation for the Northrop F/A-18L aircraft. R. A. Weeks (Northrop Corp., Hawthorne, CA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics,

New York, American Institute of Aeronautics and Astronautics, 1981, p. 271-278. (AIAA 81-2274)

A real-time, man-in-the-loop avionics systems simulation for the Northrop F/A-18L aircraft is discussed. Objectives include developing, implementing, and verifying the integration of the F/A-18L avionics systems with the human pilot. A fixed-based visual flight simulator with a high fidelity cockpit environment is used to assess pilot/system performance when subjected to multiple aircraft engagements, which provides operational characteristic simulations of the aircraft's radar, head-up display, integrated stores management, mission computer, and navigation systems. Consideration of the human pilot with the electronic systems allows early evaluations of potential problem areas, resulting in significant changes in the avionics systems.

A82-13490 * # The SIFT computer and its development. J. Goldberg (SRI International, Menlo Park, CA). In: Digital Avionics

Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 285-289. 8 refs. Contract No. NAS1-15428. (AIAA 81-2278)

Software Implemented Fault Tolerance (SIFT) is an aircraft control computer designed to allow failure probability of less than 10 to the -10th/hour. The system is based on advanced fault-tolerance computing and validation methodology. Since confirmation of reliability by observation is essentially impossible, system reliability is estimated by a Markov model. A mathematical proof is used to justify the validity of the Markov model. System design is represented by a hierarchy of abstract models, and the design proof comprises mathematical proofs that each model is, in fact, an elaboration of the next more abstract model.

A82-13498 # The electronic terrain map - A new avionics integrator. D. M. Small (USAF, Avionics Laboratory, Wright-Patterson AFB, OH). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 356-359. (AIAA 81-2289)

The map reading process is a demanding task which can be simplified by using a digital map subsystem which accesses the information needed and presents it in a form which can be easily interpreted. An electronic map subsystem can generate perspective scenes, which are essentially computer generated images of the surrounding area, and an electronic map should be much easier to interpret. In addition, essential information from the map data base can be placed on the pilots Head Up Display, reducing the need for head down operations. Work on an all electronic map for aircraft display applications was started in 1976. The design and fabrication of an Airborne Electronic Terrain Map System (AETMS) was begun in May 1980. Requirements concerning future avionics systems are examined, and a future aircraft system is discussed. Attention is given to terrain following/terrain avoidance, threat avoidance, and G.R. navigation.

A82-13499 # The interface of multifunction controls and displays to tomorrow's avionics. W. G. Mulley (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics,

1981, p. 360-364. (AIAA 81-2290)

Approaches for keeping the cost of avionics systems at a lower level are considered, taking into account the use of systems which are easy to develop, produce, operate, and maintain. The solution of a maintenance problem includes operations related to recognizing a malfunction, isolating a malfunction, correcting a malfunction, verifying the correction, and documenting the maintenance action. The cockpit can be considered a computer terminal station, and it can become the maintenance shop for all the hardware in the particular aircraft. Five hardware interfaces and one software interface can completely define all hardware and software modules for the entire display and control subsystem.

A82-13500 # An update of an integrated CNI system - TIES.
L. E. Smith and G. B. Heal (U.S. Naval Material Command, Naval Air
Development Center, Warminster, PA). In: Digital Avionics Systems
Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection
of Technical Papers. New York, American
Institute of Aeronautics and Astronautics, 1981, p. 365-371. 9 refs.
(AIAA 81-2292)

The Tactical Information Exchange System, TIES, is an integrated approach to providing the Communication, Navigation, and Identification (CNI) suite for future Naval aircraft. The system is based upon identifying the functional elements of a CNI suite and assembling them in a fashion that provides greater system reliability and availability over those currently available. TIES demonstration hardware is discussed, and the frequency conversion subsystem is considered, taking into account the HF site, the VHF/UHF site, and the Lx band site. Attention is given to the frequency division multiplex subsystem, the signal conversion subsystem, the TIES control subsystem, the data management and distribution assembly, the TIES external test, and questions regarding the further development of the TIES system.

A82-13502 # The use of separated multifunction inertial sensors for flight control. W. J. Luedde (McDonnell Aircraft Co., St. Louis, MO). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 377-382. (AIAA 81-2295)

The Multifunction Flight Control Reference System (MFCRS) program has the objective to verify that the outputs of inertial grade ring laser gyros and high quality accelerometers in a 'strapdown' configuration can be processed by a digital computer and used as the flight control feedback reference in a modern fighter, the F-15. To achieve these goals, a control law development study was performed to evaluate the effects of sensor location on flight control stability and performance. In addition, a redundance management algorithm, which uses parity equations, was developed to satisfy sensor selection and fault detection and isolation requirements. The MFCRS simulation model is considered, taking into account the F-15 flight control system, F-15 airframe dynamics, and an MFCRS sensor model. Attention is also given to sensor location studies, moment arm compensation studies, and aspects of simulator evaluation. G.R.

A82-13503 # Redundancy management of skewed and dispersed inertial sensors. D. L. Sebring (McDonnell Aircraft Co., St. Louis, MO) and J. T. Young (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 383-391. 13 refs. (AIAA 81-2296)

A redundancy management approach has been developed for strapped-down inertial instruments used as flight control reference sensors. The sensors will be installed and flight tested in a high-performance fighter aircraft (F-15) in a configuration consisting of two skewed and dispersed sensor clusters. Each cluster is an orthogonal triad of co-located, inertial-quality ring-laser gyros, and accelerometers. Two sets of logic (sensor selection and fault detection and isolation) operate in parallel, obtaining sensor selection and failure status information from stored tables. Table pointers are generated by comparing the values of parity equations to variable trip levels. An off-line, analytic computer program is used to generate the stored tables. This approach has been verified using Monte Carlo and F-15 Continuous System Modeling Program (CSMP) simulations.

A82-13504 # Development and laboratory test of an integrated sensory system /ISS/ for advanced aircraft. W. K. Toolan and A. M. Zislin (Grumman Aerospace Corp., Bethpage, NY). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

American Institute of Aeronautics and Astronautics, 1981, 392-399. 8 refs. Contract No. N62269-79-C-0206. (AIAA 81-2297)

This paper presents the results of the second phase of an Integrated Sensory Subsystem (ISS) development effort performed by Grumman under contract to the Naval Air Development Center. The ISS is a combination of redundant inertial sensors, air data probes, transducers, and other flight control related sensors, interfaces, and the associated Data Handling System (DHS). The sensor data derived within the ISS meets the requirements (i.e., performance, redundancy, survivability, etc.) for Digital Fly-By-Wire (DFBW) flight control systems. The key issue of this development phase was the synthesis and development of a DHS for dispersed arrays of flight control inertial sensors subjected to dissimilar motions due to body bending of the aircraft structure. The system design is described in terms of the hardware and Data Handling System synthesis, followed by a discussion of the methods utilized to verify system performance. (Author)

A82-13505 # Direct digital drive actuation. L. L. Kohnhorst (Rockwell International Corp., Columbus, OH). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 400-408. (AIAA 81-2298)

The Digital Flight Control System (DFCS) exploits the advantages of fly-by-wire mechanizations and digital technology while

maintaining the demonstrated safety and reliability of manual control systems. However, the use of the DFCS would increase aircraft life cycle costs and decrease operational readiness if conventional avionic hardware configuration methods are applied to new aircraft designs. One of the programs initiated by the Navy with the objective to simplify the complexity of DFCS is related to the development of the Advanced Flight Control Actuation System (AFCAS). The AFCAS is to make use of a simplified, modular, fly-by-wire actuator. The simplified actuation can be accomplished without loss in mission reliability, but with improved mean time between failure (MTBF) because of the reduced complexity. The computer interface complexity is simultaneously reduced because of circuit requirements that are more compatible with digital technology than present day analog circuits.

G.R.

A82-13506 # Applications of head-up displays in commercial transport aircraft. J. R. Lowe and J. R. Ornelas (Douglas Aircraft Co., Long Beach, CA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 409-414. 6 refs. (AIAA 81-2300)

The demanding tasks which the commercial transport pilot encounters during approach and landing are made easier by a suitable Head-Up Display (HUD) design. The HUD simplifies for the pilot tasks of decision-making, control and management. It also relieves him of the need to take his eyes from the view ahead to refer to his panel instruments. During an instrument approach, all guidance cues are available head-up whether or not any ground cues are visible. The continuously advancing state-of-the-art has improved the HUD with a larger field of view, more distinct images, and more easily followed symbology. These improvements have been made possible by advancements in HUD optic design, the use of the cathode-ray tube, the digital computer, and more sophisticated control laws. The first commercial transport HUD system in general use, now certified for the DC-9 Super 80, benefits from these improvements. G.R.

A82-13507 # Flat panel developments for future military aircraft. J. Brindle and W. G. Mulley (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 415-423. (AIAA 81-2302)

The four basic types of information for application in military aircraft are related to imaging or video, graphic, message, and discrete data. Various cockpit-mounted units are considered, taking into account the Head-Up Display, the Helmet-Mounted Display, the Mission Management Display and the Multifunction Programmable Keyboard. The display media employed include thin film electroluminescent devices, the light emitting diode, and the liquid crystal. Display addressing is discussed, giving attention to thin film transistor arrays, the integral silicon drive, the crossed electrode matrix, and the varistor. Plans for establishing technical requirements for each of the display system areas are also described.

A82-13508 * # An integrated control panel utilizing a programmable varistor-multiplexed dichroic liquid crystal display. I. J. Whitton (General Electric Co., Aircraft Equipment Div., Utica, NY). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 424-427. Contract No. NAS1-16414. (AIAA 81-2303)

Due to the conflicting demands of modern aircraft for increased systems/sensors and the decrease in cockpit panel size, weight, volume, and power, conventional discrete/dedicated methods of display and control are fast becoming obsolete. A means is sought to integrate the control and display into multifunctional programmable devices, thus giving the ability to increase system functions and yet conserve panel space. A potential solution to the control portion of the problem has come to be known as the Integrated Control Panel (ICP) approach. Flat panel display technology and controls using programmable flat panel displays with transparent capacitive touch control overlays offer the largest potential advantages. The flat panel display made of varistor-multiplexed dichroic liquid crystal (LCD)

developed by GE in recent years appears to offer the ideal monochrome solution. (Author)

A82-13513 # Digital avionics display processor. E. G. Hamilton, Jr. and S. H. Petrofsky (Emerson Electric Co., St. Louis, MO). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 466-472. (AIAA 81-2311)

This paper addresses the processing and display of the ever increasing amount of data from the new and sophisticated sensors currently being planned for aircraft use. Emphasis is placed on a display processor architecture designed for a multisensor environment. Detailed architecture description and some specific display and signal processing examples are included to illustrate data flow within this architecture. (Author)

A82-13514 # Advanced display systems for crew stations of tactical aircraft. W. G. Ast and D. E. Green (Loral Corp., Loral Electronics Systems Div., Atlanta, GA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 473-481. (AIAA 81-2312)

This paper describes the architecture and system characteristics of a family of intelligent operator/machine controlled Advanced Display Systems for use in modern tactical aircraft. A distributed processing communications link facilitates this type of a self contained control/display subsystem by minimizing demand on the central mission computer and providing flexibility in crew and cockpit display/control requirements. The major items of the Advanced Display System, including the Interactive Processing Terminal, the Universal Display Generator and the displays, are described in light of their features, capabilities and applications. The system is discussed from the standpoint of data load, timing constraints, display quality, dynamic performance and human factors. (Author)

A82-13515 # Computergraphics for aircraft control. S. F. Filarsky and W. G. Mulley (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 482-485. (AIAA 81-2313)

The Command Flight Path Display (CFPD) has been developed to demonstrate the feasibility of providing attitude, altitude, direction and speed command to the pilot in the form of an electronically generated presentation of the real world flight path which should be flown. The principal objective of the CFPD is to assure the precise and effective guidance and control of piloted aircraft at all times. The display system achieves this goal by computing the desired, or 'command' flight path and the deviations of the aircraft from that path, and then presenting a graphical representation of this combined 'director' and 'orientation' information to the pilot. Complete information on the attitude, altitude, speed and direction of the aircraft is presented continuously by the CFPD, whether the aircraft is under manual or automatic flight control. Therefore, the pilot is able to control all of the vehicle's six degrees of freedom by reference to the single, integrated display. The flight path display concept may be applicable to all phases of flight eventually, but the present developmental effort is confined to earth-referenced applications. Accordingly, the feasibility demonstration was limited to three such applications: takeoff, landing and fixed-target, air-to-ground attack. (Author)

A82-13516 * # An advanced programmable/reconfigurable color graphics display system for crew station technology research. R. J. Montoya (Research Triangle Institute, Research Triangle Park, NC), J. N. England (IKONAS Graphics Systems, Inc., Raleigh, NC), J. Hatfield (NASA, Langley Research Center, Hampton, VA), and S. A. Rajala (North Carolina State University, Raleigh, NC). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 486-498. 6 refs. (AIAA 81-2314)

The hardware configuration, software organization, and applications software for the NASA IKONAS color graphics display system are described. The systems were created at the Langley Research Center Display Device Laboratory to develop, evaluate, and demonstrate advanced generic concepts, technology, and systems integration techniques for electronic crew station systems of future civil aircraft. A minicomputer with 64K core memory acts as a host for a raster scan graphics display generator. The architectures of the hardware system and the graphics display system are provided. The applications software features a FORTRAN-based model of an aircraft, a display system, and the utility program for real-time communications. The model accepts inputs from a two-dimensional joystick and outputs a set of aircraft states. Ongoing and planned work for image segmentation/generation, specialized graphics procedures, and higher level language user interface are discussed. M.S.K.

A82-13517 # Higher order Information Transfer Systems are coming. J. W. McCuen (Hughes Aircraft Co., Fullerton, CA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 499-506. 11 refs. (AIAA 81-2317)

The functions necessary for airframe/weapons system integration in advanced avionics systems are reviewed, noting the relevance to the establishment of a military standard Information Transfer System (ITS). The requirements driving the changes from older avionics systems are listed, and the importance of hierarchical interconnections in multilevel, multiplexed ITSs to provide lower level ITSs with functionally isolated communications media whenever data interchange is needed is stressed. Flow diagrams for three-and two-level ITSs are provided; a topology of the designs includes functional isolation between critical flight subsystems. New subsystems such as fire control, stores management, weapon guidance, and release will be combined into one subsystem. Independently operating subsystem bus networks will be tied together by higher order systems operating between 1-50 MHz.

M.S.K.

A82-13518 # Advanced fiber optic systems for avionics applications. B. E. Kincaid (Lockheed Research Laboratories, Palo Alto, CA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 507-513, 27 refs. (AIAA 81-2319)

The application of fiber optic (FO) systems to avionics is considered, with emphasis on the design of electronic warfare (EW) systems requiring high-speed, real-time data transfer busing and wavelength multiplexing. Single star, three in-line star, and three fully-interconnected star FO data bus architectures are compared with respect to optical loss equations, maximum number of terminals, number of required fibers and bulkhead connectors, optical dynamic range required, and multipath levels for interconnected loop architectures. It is found that the single star configuration is optically superior to the two alternatives, although simplex stars must be added to the single star in order to lessen the installation cost and reliability disadvantages associated with the configuration's large number of fibers and the large pin count in a bulkhead connector.

A82-13519 # Light-guided information distribution systems. H. P. Lavin (General Electric Co., Aircraft Equipment Div., Utica, NY) and G. B. Harrold (GE Electronics Laboratory, Syracuse, NY). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 514-521. (AIAA 81-2320)

This paper examines the pervasiveness of light-guided communication systems into the avionics interconnect system. The capabilities and limitations of current technology are presented together with system architectural alternatives such as the use of wavelength multiplexing of time division and frequency division signals with various modulating schemes. Transducer design techniques for the conversion from electrical to optical signals and optical to electrical signals are presented with some of the limitations of conventional analytical techniques. The extension of light-guided communications into the avionics backplane enhances system growth capability and technological transparency by information broadcasting among the

avionics modules. The experimental results of a preliminary lightguided backplane are presented using optics on a wire-wrap backplane to transfer digital clock, data, and control information for a maximum distribution to 40 loads. (Author)

A82-13520 * # On-board communication for active-control transport aircraft. L. D. Brock, A. L. Hopkins, Jr. (Charles Stark Draper Laboratory, Inc., Cambridge, MA), and J. L. Spencer (NASA, Langley Research Center, Hampton, VA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 522-529, Contract No. NAS1-15359. (AIAA 81-2321)

An investigation of active control communications sponsored by the NASA Langley Research Center is summarized Particular attention is given to comparative architectures, for which a common set of requirements is generated as a baseline. Most of the requirements are aircraft functional in nature, such as stability and command augmentation, structural load relief, flight path control. flight control linkage, flight monitoring, management, navigation. engine control, and ground communication; the time element, the hazard environment, and the communications capacity estimation are also important factors. The architectures involve several communication technologies, including dedicated links, broadcast busing, and multiplex busing. The multiplex bus system provides the greatest flexibility and installation efficiency. A future homogeneous network system is also proposed, which would be fault and damage tolerant and would, with advanced technology, avoid the problems of designing a very large and flight critical multiplex bus system. J.F.

A82-13525 * # Digital detection and processing of laser beacon signals for aircraft collision hazard warning. L. M. Sweet, R. B. Miles, G. F. Russell, M. G. Tomeh, S. G. Webb, and E. Y. Wong (Princeton University, Princeton, NJ). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 563-571. 15 refs. Grants No. NCC2-94; No. NGL-31-001-252. (AIAA 81-2328)

A low-cost collision hazard warning system suitable for implementation in both general and commercial aviation is presented. Laser beacon systems are used as sources of accurate relative position information that are not dependent on communication between aircraft or with the ground. The beacon system consists of a rotating low-power laser beacon, detector arrays with special optics for wide angle acceptance and filtering of solar background light, microprocessors for proximity and relative trajectory computation, and pilot displays of potential hazards. The laser beacon system provides direct measurements of relative aircraft positions; using optimal nonlinear estimation theory, the measurements resulting from the current beacon sweep are combined with previous data to provide the best estimate of aircraft proximity, heading, minimium passing distance, and time to closest approach. (Author)

A82-13526 # An operational model of specific range for microprocessor applications in piston-prop general aviation airplanes. R. C. H. Parkinson. In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 572-579. 19 refs. (AIAA 81-2330)

This paper presents a fuel-efficient cruise performance model which facilitates maximizing specific range of General Aviation airplanes powered by spark-ignition piston engines and propellers. Airplanes of fixed design only are considered. Specific range is the ground distance the airplane flies per unit mass of fuel consumed in cruising flight. The cruise performance model determines the specific range, engine inlet manifold pressure, engine fuel-air mass ratio and engine fuel flow rate which correspond to any given values of geocentric true windspeed along track, equivalent airspeed, airplane gross weight, airplane longitudinal center of gravity position. auxiliary equipment power usage, engine rotational speed, pressure altitude and atmospheric ambient temperature. The use of the cruise performance model for maximizing specific range, with and without constraints on the airplane operation, is discussed. The cruise performance model appears suitable for airborne microprocessor implementation. Improvements in specific range, which are expected to result from implementation of the cruise performance model, are

given. The principal hardware items necessary for such implementation are listed. (Author)

A82-13527 # Design and flight test of a lateral-directional command augmentation system. D. Atzhorn (USAF, Washington, DC) and R. F. Stengel (Princeton University, Princeton, NJ). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics,

New York, American Institute of Aeronautics and Astronautics, 1981, p. 580-592. 14 refs. Contract No. N00014-78-C-0257. (AIAA 81-2331)

Two-input/two-output lateral-directional control laws with Type 0 and Type 1 structures have been designed, analyzed, and flight-tested using the microprocessor-based digital flight control system (Micro-DFCS) installed in Princeton's Variable-Response Research Aircraft (VRA). These control laws were designed using linear-quadratic sampled-data regulator theory, and they were evaluated by U.S. Navy test pilots. Major closed-loop response features were found to be relatively insensitive to sampling rate (down to 4 sps), although flying qualities were degraded by increased sampling delay. Type 0 controllers provided satisfactory performance in flight, but the equivalent Type 1 systems were found to be unduly sensitive to disturbances and measurement noise. A novel application of the Tustin transformation proved useful in control law implementation. (Author)

A82-13529 # Fiber-optic immunity to EMI/EMP for military aircraft. M. K. Zaman (Lockheed-California Co., Burbank, CA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 597-599. (AIAA 81-2339)

Fiber-optic interconnect technology is specifically suited for military aircraft. This paper addresses a major factor of the fiber-optic interconnect technology, namely, the fiber-optic immunity to EMI/EMP, including power line transients and lightning strike. Transmission systems using fiber-optic cables (interconnect) are similar to those using electrical cables (balanced shielded twisted pairs), except that the output of the transmitter is used to modulate a light source. A photodetector responds to the light transmitted by the optical fiber, producing an electrical signal corresponding to the output of the modulated source. This signal can then be processed in a conventional manner in the system. In general, fiber-optic cables are not susceptible to EMI, provide good electromagnetic isolation between circuits, provide wide bandwidth, and are lightweight. Fiber-optic cable characteristics will be explored for shielding effectiveness. The EMI tests conducted to quantify the EMI benefits of fiber-optic cables in aircraft environments will also be discussed. No information related to transient radiation effects on electronics (Author) (TREE) is presented in this paper.

A82-13530 # Real-time flight management avionics software system. J. Chelini and R. H. Farmer (General Motors Corp., Delco Electronics Div., Goleta, CA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 600-607. (AIAA 81-2340)

Recently, the U.S. Air Force evaluated several varieties of Fuel Savings Advisory Systems (FSAS) including a Flight Management System (FMS) considered in the reported investigation. It is pointed out that the engineering effort to provide Flight Management Systems for commercial and military applications is extremely software intensive. To minimize software development efforts, an enlargement of the abstract computing machine was required. This resulted in the development of a kernel. A description is provided of the history associated with the development of a kernel and its use in FMS applications. It is demonstrated that through the use of solid software engineering methodology and proven operating system technology, Fuel Management System software is maintainable and error free, lending itself to a variety of configurations and demands with minimum software costs.

G.R.

A82-13531 # Time-referencing of data in an asynchronous environment. B. D. Brumback (General Dynamics Corp., Fort Worth, TX). In: Digital Avionics Systems Conference, 4th, St. Louis, MO,

November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 608-613. (AIAA 81-2341)

The time-referencing of data in an avionic system that is based on asynchronous processing is discussed. The time-tag counter, provided by MIL-STD-1553B, is used to precisely define the age of data. An avionic system, which uses three asynchronous multiplex buses, is discussed as an example. A timing-uncertainty error budget is defined and the corresponding position and velocity errors are negligible when compared with the errors in a high-quality navigation sensor. (Author)

A82-13532 * # A Loran-C prototype navigation receiver for general aviation. R. W. Lilley and D. L. McCall (Ohio, University, Athens, OH). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 614-620, 10 refs. Grant No. NGR-36-009-017, (AIAA 81-2329)

Investigations have been conducted regarding the techniques required for Loran-C navigation with application to the general-aviation pilot. The goal has been to produce prototype equipment for flight evaluation which will provide enroute navigation in both latitude-longitude and rho-theta coordinates and to evaluate the nonprecision approach capabilities of such equipment. In connection with the considered project, a prototype Loran-C receiver has been flight-tested using a variety of flight paths, with and without simultaneous ground radar position data collection. Attention is given to a receiver overview, an antenna preamplifier/coupler, the Loran-C receiver RF processor, the tracking loop hardware, tracking loop programming, video output, the laboratory and flight evaluation, and work currently in progress.

G.R.

A82-13533 # Advanced weapon systems - Integration technology. M. J. Thullen (USAF, Avionics Laboratory, Wright-Patterson AFB, OH). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers.

New York, American Institute of Aeronautics and Astronautics, 1981, p. 621-628. (AIAA 81-2213)

The Digital Avionics Information System (DAIS) is discussed. DAIS has been characterized as a system architecture which can be applied and configured for a broad class of avionics applications and missions utilizing digital technology to reduce life cycle costs by defining and developing modular hardware and software core elements and standardized interfaces which can be configured and applied to many aircraft. The DAIS approach reflects a total system concept rather than a functional subsystem or hardware oriented system. The DAIS architecture consists of federated processors communicating with each other and the other system elements through a standardized multiplex data bus. Advanced avionics concepts are discussed, taking into account information fusion, functional automation, integrated subsystems, advanced architecture, and aspects of concept validation.

A82-13534 * # Low cost programmable multisimulator facility. J. G. Kreifeldt (Tufts University, Medford, MA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 629-632. 7 refs. Grants No. NsG-2156; No. NCC2-93. (AIAA 81-2229)

A prototype, low cost multisimulator facility consisting of a DEC LSI-11 host computer and multiple desk top simulators is reported. The facility includes a main-frame system, a voice system, and a multi-cab system which consists of a flight panel, a host subsystem, and a flight simulator system. Software components are described, and the simulator computer, which provides flight dynamics, a path predictor, and navigation and data communications is discussed. The system may be computationally upgraded by specification of the DEC LSI-11/23, thus obtaining at least a two-fold increase in real-time computational power.

D.L.G.

A82-13560 † Divergence of a sweptforward wing (Divergentsiia kryla s obratnoi strelovidnost'iu). A. P. Seiranian. Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela, Sept.-Oct. 1981, p. 133-138. 10 refs. In Russian.

Equations describing the divergence of a sweptforward wing are examined and found to contain a small parameter. The perturbation method for an arbitrary wing is used to obtain a formula relating the critical divergence rate with the basic characteristics of the wing. Numerical results are obtained using a variational method.

P.T.H.

A82-13600 Civil aviation in China. R. Goodson. *Interavia*, vol. 36, Nov. 1981, p. 1098-1102.

An account is given of the present capabilities and development plans of the General Administration of Civil Aviation of China (CAAC), which has over 160 domestic routes, provides scheduled services to more than 80 Chinese cities, and operates 17 international routes. It is reported that, of the 120 airports in the People's Republic of China, only 12 can handle 707 airliner operations and less than 10 those of the CAAC's recently acquired 747SPs. Among the operational problems cited are the use of 24 different aircraft types and the acquisition cost of such advanced aircraft as the Airbus A300. Of great importance is the ability of the CAAC to purchase aviation fuel directly from the Chinese government, at prices 10-20% lower than those privately owned airlines pay. Attention is given to airport facilities, research and agricultural aircraft operations, and the effects of regional government policy.

A82-13701 † Estimation of the efficiency of radioelectronic flight navigation systems (Otsenka effektivnosti radioelektronnykh pilotazhno-navigatsionnykh kompleksov). M. S. larlykov and A. S. Bogachev. *Radiotekhnika*, vol. 36, Sept. 1981, p. 7-12. In Russian.

A method based on the theory of Markov processes is developed for estimating the efficiency of flight navigation avionics. System components are modeled with three states, which makes it possible to investigate the permanent and temporary malfunctions. Particular attention is given to the selection of a criterion for the operational efficiency of the navigation system, and to the determination of operational states of the system.

B.J.

A82-13703 † Digital signal processing on a background of rereflections for the international aircraft landing system (Tsifrovaia obrabotka signala mezhdunarodnoi sistemy posadki samoletov na fone pereotrazhenii). A. K. Berniukov. *Radiotekhnika*, vol. 36, Sept. 1981, p. 26-29. 7 refs. In Russian.

An analysis of multibeam signals in the time-reference scanning-beam (TRSB) system is presented for the case of rereflections and minimum a priori information. Algorithms of real-time digital processing are proposed, which make it possible to discriminate the signal from the rereflection, and to measure the information parameter.

B.J.

A82-13852 * # Powered-lift takeoff performance characteristics determined from flight test of the Quiet Short-haul Research Aircraft /QSRA/. D. W. Riddle, R. C. Innis, J. L. Martin, and J. A. Cochrane (NASA, Ames Research Center, Moffett Field, CA). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2409. 14 p. 12 refs.

A powered-lift, reduced thrust takeoff performance program utilizing quiet short-haul research aircraft has been conducted. It has been shown that the powered-lift upper surface blowing concept greatly enhances aircraft takeoff performance. The improvements include: (1) takeoff field lengths may be shortened by approximately 30%; (2) Air Force critical field lengths may be shortened by approximately 60%; (3) powered lift upper surface blowing aircraft have better handling and performance characteristics than comparable conventional aircraft; and (4) the low speeds associated with powered-lift takeoff enhance safety margins.

S.C.S.

A82-13853 * # Thunderstorm hazards flight research - Program overview, P. L. Deal, G. L. Keyser, B. D. Fisher, and N. L. Crabill (NASA, Langley Research Center, Hampton, VA). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2412. 11 p. 7 refs.

The NASA thunderstorm hazards research program, designed to study the effects of lightning strikes on the design and operation of aircraft, is described. An all-weather F-106B is instrumented to document the EM characteristics of direct and nearby strikes, measure the field parameters and analyze the ambient atmospheric

content, and film the strikes; X-ray detectors are also on board, along with instrumentation for determining the frequency of visible light waveforms. Data is either recorded on-board or sent by telemetry to base, while ground based telemetry is used to direct the pilot and craft into regions of optimal lightning activity. The sensing apparatus is described, and ongoing programs to correlate different storm parameters are reviewed, along with operational procedures and safety precautions. Continued use of the craft through 152 storms and 16 direct hits, with no fatalities or circuit breaker throw, confirms the ability of metal skinned aircraft to withstand lightning strikes; data gathered from flights during 1980 are provided. D.H.K.

A82-13854 # Enhanced F-15 air-to-ground flight demonstrations. G. D. Gibbs (McDonnell Aircraft Co., St. Louis, MO). A/AA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, A/AA Paper 81-2413. 6 p.

Features designed to enhance the F-15 Eagle air-to-ground capabilities are presented. The F-15, intended to provide battlefield air superiority, has a thrust/weight ratio exceeding one-to-one; its armament systems are outlined. Built-in flexible digital avionics have allowed in-weather performance using synthetic aperture radar (SAR), high resolution mapping, and incorporation of an infrared laser sensor pod for use once in target range. The SAR has a resolution of 8.5 ft at 10 miles, suitable for detecting surface vehicles. The flight range has been extended with conformable fuel tanks, which, though adding a small drag increase beyond Mach 1, has doubled the internal fuel capacity; a full fuel load is now 5,120 gal, enough for more than a transatlantic flight. Two seven in. and four two in. CRT displays have been mounted in the aft cockpit, which now has complete flight control capability. Patch mapping, target identification, and blind bombing test flights are described.

D.H.K.

A82-13855 # The F-16/79 test program. K. G. Timpson (General Dynamics Corp., Fort Worth, TX). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2414. 8 p.

Flight certification testing for the F-16 fighter outfitted with a J79 engine (F16/79) is described. The use of the J79 engine required a new inlet, a new secondary air variable by-pass system, nacelle structural insulation blankets, and adaptation of the fire detection system and installation of a fire extinguishing system. The tests were concerned only with systems which were affected by the change of engine; 350 test runs were flown. Flight test procedures are outlined, chronography is provided, and instrumentation for real-time telemetry is discussed. A total of thirteen months elapsed between the decision to outfit the export version of the F-16 with a different engine and the completion of the flight certification trials; the results of the tests are now under review by the Air Force.

D.H.K.

A82-13856 # Organizing and training for innovative flight test management. J. D. Lang (USAF, Wright-Patterson AFB, OH). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2416.8 p. 6 refs.

The organization and training for innovative flight test management by the 4950th Test Wing is reported. Current wing structure, methods, planned changes, and employer/employee relationships are discussed. An in-house training program to assist in the transition from old to new by enhancing attitudes and clarifying roles for improved leadership in test project and test engineering management is presented. Future emphasis is also discussed, and is to be on organizational attitude to encourage innovation and motivation to make each project succeed.

D.L.G.

A82-13857 * # Flight experience with a remotely augmented vehicle flight test technique. K. L. Petersen (NASA, Flight Research Center, Edwards AFB, CA). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2417. 19 p. 7 refs.

A flight technique which uses the remotely augmented vehicle (RAV) concept is developed to flight test advanced control law concepts. The design, development and flight test validation of a RAV system mechanized on a digital fly-by-wire aircraft are described, and future applications are discussed. Flight experiments

investigate complete inner loop, low sample rate, and adaptive control system mechanisms. The technique, which utilizes a ground-based FORTRAN programmable digital computer and up and down telemetry links is found to provide the flexibility necessary to effectively investigate alternate control law mechanisms in flight.

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A82-13859 # A technique to determine lift and drag polars in flight and their application. A. Knaus (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2420. 13 p.

The paper presents performance trials of the European combat aircraft Tornado, which concentrate on techniques used to measure lift and drag polars. The polars are measured by means of well adapted test instrumentation, a data reduction system, and a high calibration standard for the aircraft and engines. Steady state and dynamic test maneuvers are combined, and result in a significant reduction in flight time required to obtain sufficient data for determining zero lift drag, induced drag characteristics, and drag increments due to aircraft configuration change. Flight test results are presented, which demonstrate the advantages of the test technique, the high data quality, and the feasibility of in-flight verification over the entire angle of attack range.

D.L.G.

A82-13861 # A cost effective method for the control of roll due to side slip on a low speed aircraft. S. Chandrashekar and N. S. Kiran (Hindustan Aeronautics, Ltd., Flight Test Dept., Bangalore, India). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2422. 5 p. 5 refs.

Dihedral effect and its control are important for increasing damping of dutch roll, as well as reducing roll damping and unstable spiral modes. The effectiveness of setting the wing-tips at large anhedral angles to reduce the dihedral effect is demonstrated for the case of a low wing piston trainer with a positive geometric dihedral. Results of flights conducted with four wing-tip an/dihedral values showed that the effective dihedral changed its sense when the aircraft was flown with a 30 deg wingtip anhedral; this change in sense occurred at about 10 deg tip-anhedral. The method was found to be both time and cost effective compared with conventional methods. Lack of agreement with analytical estimates indicates the need to review the analytical methods, which were based on results from wind tunnel measurements.

J.F.

A82-13863 # Performance estimation from non-steady manoeuvres. K. R. Nippress (Aeroplane and Armament Experimental Establishment, Boscombe Down, Wilts., England). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2424. 11 p.

Data obtained from non-steady manoeuvers on modern high performance aircraft have been analysed using least squares regression techniques to produce thrust drag models of the aircraft. Predictions of level speed performance, climb performance and turning performance have been produced from the model data and compared with data obtained from traditional test methods. The results presented in this paper demonstrate that use of non-steady techniques offers the possibility of decreasing the flight time required to perform a performance evaluation to approximately one quarter of the time required by traditional steady techniques.

(Author)

A82-13869 # Navy performance modeling techniques. R. W. Boyd (U.S. Navy, Naval Air Test Center, Patuxent River, MD). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2431. 5

Details of airframe/engine/installation models combined with flight test data to achieve accurate performance modeling are presented. The airframe performance (drag) and engine performance (thrust) have separate computer programs which accompany the components from initial design to flight testing, and are updated with each modification to the hardware. Wind tunnel and flight test measurements are input as drag parameters while engine operational

parameters are input into the thrust model. Once installation has been accomplished, a flight test model is developed which must be overlaid with the data from the initial thrust and drag models. A flowchart is presented for performance modeling, and the maneuvers and acceleration tests are described; the performance model is fed into a computer with graphics capability for analysis by project engineers.

M.S.K.

A82-13871 * # HiMAT aerodynamic design and flight test experience. N. W. Matheny (NASA, Flight Research Center, Edwards AFB, CA) and G. N. Panageas (Rockwell International Corp., North American Aircraft Div., Los Angeles, CA). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2433. 18 p. 5 refs.

Consideration is given to the design phase of the highly maneuverable aircraft technology program. Design objectives are examined, noting full-scale design and the remotely piloted research vehicle. Attention is given to subsonic, transonic, and supersonic design. Design results are discussed with reference to aerodynamic efficiency, aeroelastic tailoring, and the flight test program. S.C.S.

A82-13872 # In-flight computation of helicopter transmission fatigue life expenditure. K. F. Fraser (Department of Defence, Aeronautical Research Laboratories, Melbourne, Australia). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2434. 10 p. 5 refs.

Estimates of the safe fatigue life of critical helicopter transmission components may be made if in-service load data together with component fatigue data are available. Instrumentation has been developed to provide in-flight computation and indication of the current values of fatigue life expended for critical gears in single or twin-engine helicopter transmission systems. In addition basic transmission load data in the form of totalized times spent in a number of contiguous torque bands are continually updated and stored during flight. The basic load data together with values of life expenditure for critical gears for the current flight can be automatically printed out after flight. This development opens the way towards fatigue life monitoring of individual transmissions. (Author)

A82-13873 # Advancing blade concept /ABC/ development test program. A. J. Ruddell (United Technologies Corp., Sikorsky Aircraft Div., West Palm Beach, FL). A/AA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, A/AA Paper 81-2437. 10 p. 10 refs.

The Advancing Blade Concept (ABC) rotor system derives its name from the fact that the predominant lift load at high forward speeds is carried by the advancing blades on both sides of the aircraft. Since the retreating blades are not required to carry a significant fraction of the total lift load at forward speed, the speed and load factor limitations of the conventional helicopter due to retreating blade staff are eliminated. ABC development began in 1964. The XH-19A ABC demonstrator aircraft was designed as a research tool to investigate the ABC rotor characteristics. A brief review of the concept principles is presented along with a description of the test aircraft. It is pointed out that the XH-59A flight program has completed a successful demonstration of the ABC rotor system. The XH-59A has demonstrated significant maneuver and performance improvements over conventional helicopters.

G.R.

A82-13874 * # Recent propulsion system flight tests at the NASA Dryden Flight Research Center. F. W. Burcham, Jr., L. P. Myers, J. Nugent, P. L. Lasagna, and L. D. Webb (NASA, Flight Research Center, Edwards AFB, CA). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2438. 13 p. 13 refs.

The article presents a summary of the propulsion system tests conducted on a number of aircraft at the NASA Dryden Flight Research Center. The tests included digital engine control systems, engine-inlet compatibility, inlet-airframe interactions, nozzle-boattail drag and advanced turboprop acoustics. Among the aircraft evaluated were the F-15, HiMAT, F-14, and the JetStar.

S.C.S.

A82-13875 # C-5A unsurfaced taxi and off-load demonstrations. R. A. W. Brown (Lockheed-Georgia Co., Engineering Flight

Test Div., Marietta, GA). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981. AIAA Paper 81-2439. 10 p.

The results of tests to evaluate the C-5A maneuvering and off-load capabilities on unsurfaced soils are presented. Clay-sand, sand, and silty clay soils with a CBR of nine were chosen for runways for the 665,000 lb fully loaded vehicle. Weight was gradually built up to the maximum, using a field with drop-offs no greater than six in. and driving at 5-10 knots. Conditions were created for dry sand, wet ground, snow, and frozen soil. Maneuvering was accomplished in ruts up to 8 in. deep in loose sand and 15-21 in. deep in snow; towing was not considered essential because the C-5A has rolling, rather than powered, wheels. The C-5A was judged operable under the test conditions, and recommendations are given for expanding the number of airfields available for the C-5A by using methods developed in the present tests as reference marks for soil evaluation.

A82-13876 # The Cessna T303 Crusader. T. E. Wallis and M. O. Schlegel (Cessna Aircraft Co., Wichita, KS). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2440.7 p.

The Cessna T303 Crusader is a six-place twin with a gross weight of 5150 pounds and an IFR equipped useful load of over 1850 pounds. Extensive initial computer and wind tunnel studies have resulted in an airplane with truly superb flying qualities. A cruciform tail configuration with a high aspect ratio horizontal tail, and advanced flow control devices in critical areas contribute much to these characteristics. The turbocharged 250 bhp engines have a unique turbocharger/compression ratio combination which provides excellent fuel economy. The paper describes the airplane and the development and certification flight test program. (Author)

A82-13877 # Government testing. J. C. O'Connor (U.S. Army, Aviation Research and Development Command, St. Louis, MO. AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV. Nov. 11-13, 1981, AIAA Paper 81-2443. 4 p.

The Department of Defense Directive on Test and Evaluation establishes the policy of conducting test and evaluation throughout the acquisition process of a defense weapon system. The acquisition process consists of four distinction phases, with each phase requiring a particular scope and type of test. This paper addresses the flight testing required for each acquisition phase during the development and production of Army aircraft. The test objectives, scope of tests, and test methodology are presented for the Preliminary Airworthiness Evaluation, Developmental Tests, Operational Tests, artificial/natural inflight icing, climatic laboratory tests, and the Airworthiness and Flight Characteristics Tests. (Author)

A82-13878 * # Flight test method for the determination of reciprocating engine cooling requirements. S. J. Miley, E. J. Cross, Jr. (Texas A & M University, College Station, TX), and D. L. Lawrence (Piper Aircraft Corp., Lakeland, FL). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2446. 6 p. Grant No. NsG-1083.

It is pointed out that the effective cooling of aircraft reciprocating engines is still a problem area for the general aviation industry. Miley et al. (1981) have reported the results of an investigation of problems associated with cooling and installation aerodynamics. A description is given of a flight test procedure which was developed in connection with the considered investigation. It is shown that the test procedure provides valid cooling requirements data for a particular installation. The data are in terms of easily measurable parameters. The employment of the test procedure, which is based on the NACA cooling correlation method, can lead to more effective cooling installations and the solution of existing cooling problems.

G.R.

A82-13879 # Performance assessment of an advanced reheated turbo fan engine. V. Zeidler (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2447. 15 p.

Testing and evaluation techniques for rating the performance of

an advanced reheated turbofan engine are reported. Thrust, specific fuel consumption, and engine operational qualities are calculated for input into a computer. Thrust evaluation requires gross thrust and air mass flow measurements, which are taken as far as possible downstream from the engine, and are linked as input. Other options for thrust evaluation are described, noting that each possesses slight degradations in accuracy. Calibration curves are diagrammed for each option, and the performance evaluation of convergent nozzles is outlined. Calibration runs are performed in an altitude test facility (ATF) with totally controlled inputs to simulate the conditions in which test flights will be flown. Highest accuracy is obtained using linked methods and two engines in the ATF for performance and aircraft drag evaluation.

M.S.K.

A82-13880 * # Selected stability and control derivatives from the first Space Shuttle entry. K. W. Hiff,R. E. Maine (NASA, Flight Research Center, Edwards, CA), and D. R. Cooke (NASA, Johnson Space Center, Houston, TX). A/AA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, A/AA Paper 81-2451. 16 p. 10 refs.

Primary stability and control derivative estimates garnered from the first Shuttle entry are reported. The craft was the first vehicle to maneuver over a wide range of hypersonic velocities, yielding data on flight characteristics from previously unexplored regimes. The flight envelope was confined to entry and safe landing, with no additional maneuvers to gain control data. Data for a Mach number range of 25-1.5 and altitudes of 515,000-50,000 ft are provided, and functional ranges of the Shuttle control surfaces and attitude jets are outlined. On-board systems gathered data on aerodynamic coefficient identification, flight condition and Euler angles, and jet chamber pressures. A maximum likelihood estimation program, which contained unknown stability and control derivatives, was used for control; a control input determined the value of the unknown derivatives, and the input and spacecraft response were measured Longitudinal and lateral directional maneuvers and their derivative estimates are described, noting wind contamination of the sideslip measurements below Mach 3. Further maneuvering and stability tests are projected for subsequent flights.

A82-13881 # Planning a helicopter flight test program, K. Kuppuswamy and N. S. Kiran (Hindustan Aeronautics, Ltd., Flight Test Dept., Bangalore, India). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2381. 6 p.

A study has been undertaken to assess the feasibility of completing the flight test program for the three different prototypes of the Advanced Light Helicopter, a high-performance twin-jet craft designed to operate under Indian conditions, within the 30 months allotted for the purpose. It was found that in order to achieve the 1000 hours of flight time required, all prototypes must carry identical instrumentation packages capable of making about 100 different dynamic, quasi-static and identifying measurements, with a fourth package as backup. Analysis of the weight of such an instrumentation package indicates it to contribute about 400 kg to the weight of the helicopter, with one third of the total represented by cables and connectors. Cost estimates reveal over 50% of the program cost per flight hour to be accounted for by insurance and depreciation, while the more controllable engineering and flying costs make up only 33% of the total. Finally, a study of expected reliability, availability and maintainability of the test vehicle, airborne data acquisition system and telemetry system reveals that they are compatible with the planned schedule.

A82-13888 # Recent improvements at the Naval Air Test Center for increased test system flexibility. T. F. Coyle, G. A. Davis, and G. R. Ryan, Jr. (U.S. Navy, Naval Air Test Center, Patuxent River, MD). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2392. 10 p.

Improvements that have been made in two real-time systems used daily at the Naval Air Test Center are described. The systems are the Real-time Telemetry Processing System (RTPS) and Range Computation and Control System (RCCS). The improvements have made possible (1) rapid changes to real-time application programs; (2) increased flexibility in data reduction; (3) increased capability in

data analysis; and (4) increased capability in range control systems. It is pointed out that these improvements will enable the RTPS and the RCCS to provide the necessary support for the test and evaluation of both vehicles and mission systems at the center in the 1980's. C.R.

A82-13891 # Flight testing the nonmetallic spline coupling technology at the Naval Air Test Center. P. F. Zalesak, Sr. (U.S. Navy, Naval Air Test Center, Patuxent River, MD). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2405. 12 p. 18 refs.

Results of a flight test program are discussed and data are presented in support of the contention that the nonmetallic spline coupling technology can be used to reduce unwanted oscillatory torsional loads transmitted between components. It is shown that the nonmetallic spline coupling technology can be applied to existing hardware systems to improve the reliability of components used to transmit torque. In the test, transmitted torsional load data, as measured at the engine driven compressor test drive shaft, were collected during several flight phases, including takeoff, takeoff abort, negative torque system check, loiter flight conditions at 500 feet and 200 knots indicated airspeed, inflight engine shutdown, inflight engine start up, landing and ground backing up operations.

C.R.

A82-13892 # Commentary on facilities used in the development of a Sea Harrier all weather operations capability. J. W. Britton (Royal Aircraft Establishment, Bedford, England). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2407. 8 p.

The resolution of difficulties inherent in developing an all-weather V/STOL aircraft (Sea Harrier) for sea operations is described, along with the test facilities used for the program. Reduced visibility, which restricts pilot instrument use after a certain point while landing, were explored with flight simulators? with four-axis motion. The simulator provided motion fidelity, head-up displays, realistic visual and environmental conditions (digital computer controlled), and a TV video system. Additional flight test use was made of a Harrier two-seater equipped with blinds to alter visibility. Visual guidance aids comprising flashing red and white lights and runway markers were employed to provide strong visual cues for pilot orientation during approach. The advantages of having all equipment on-site are stressed, as data from one test is then available for simultaneously run test phases.

D.H.K.

A82-13894 # Information technology and its impact on test and evaluation at the Naval Air Test Center. R. K. Fairfax, T. C. Lancaster, and G. F. Hurlburt (U.S. Navy, Naval Air Test Center, Patuxent River, MD). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2396.7 p. 13 refs.

An investigation is conducted regarding the approaches used by the Naval Air Test Center to provide data collection, reduction, and computer support requirements for full-scale aircraft development programs such as the F/A-18, AV-8B, and LAMPS MK-III. Aspects of initial real-time development are discussed, taking into account network components, the data transmission network, the fiber optic cable, the interface equipment, the real-time processor, telemetry application, questions of range application, and problems of graphics application. A description of a satellite communications demonstration is also provided.

A82-13898 # Georgia Tech coherent jammer flight test. H. W. Andrews and D. L. Gordon (Georgia Institute of Technology, Atlanta, GA). AIAA, SETP, SFTE, SAE, ITEA, and IEEE, Flight Testing Conference, 1st, Las Vegas, NV, Nov. 11-13, 1981, AIAA Paper 81-2452.7 p.

A test program to accurately measure the interaction between a coherent jammer and a radar is described. Theoretical calculations comprised finding closed form solutions for the jammer/radar interaction, and considered slant range antenna patterns, radar cross section, frequency, polarization, and scenario geometry, in addition to the development of computer programs to study electronic countermeasures techniques. A jammer was devised to meet the specifications derived from the analytical work and mounted on a test aircraft with 14 track analog pulse-to-pulse recording equipment.

The data acquisition systems and data flow are diagrammed and experimental procedures are outlined for a radar pulse ratio frequency of 2800 Hz and a pulse width of 0.5 microsec. The plane will follow head on zig-zag and constant off set flight paths toward the radar to test the jammer capabilities.

A82 13903 # Fleet Flight Loads Survey monitoring and analysis techniques D A Rakin (Grumman Aerospace Corp Bethpage NY) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2461 12 p

The F 14 Fleet Flight Loads Survey program collected data from operational fleet aircraft for the generation of full scale fatigue test spectra and fatigue design criteria. Thirty five channel tape recorders were installed in each of four fleet aircraft to measure aircraft kinematic parameters surface position and airframe strains. Computer software was developed to reduce the data to the form of exceedance plots and bivariate exceedance tabulations. Regression equations were generated from structural flight test data and used to generate exceedance plots of major airframe surface loads.

A82 13906 * # Flight test experience with high-alpha control system techniques on the F 14 airplane J Gera R J Wilson E K Enevoldson (NASA Flight Research Center Edwards CA) and L T Nguyen (NASA Langley Research Center, Hampton VA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2505 22 p 5 refs

Improved handling qualities of fighter aircraft at high angles of attack can be provided by various stability and control augmentation techniques NASA and the U.S. Navy are conducting a joint flight demonstration of these techniques on an F.14 airplane. This paper reports on the flight test experience with a newly designed lateral directional control system which suppresses such high angle of attack handling qualities problems as roll reversal wing rock, and directional divergence while simultaneously improving departure/spin resistance. The technique of integrating a piloted simulation into the flight program was used extensively in this program. This technique had not been applied previously to high angle of attack testing and required the development of a valid model to simulate the test airplane at extremely high angles of attack. (Author)

A82 13907 # Flight testing De Havilland Aircraft Limited DASH 8 utilizing onboard data analysis by microprocessor W M Gibson (De Havilland Aircraft of Canada Ltd Downsview, Ontario, Canada) AIAA SETP SFTE SAE ITEA and IEEE FLight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2507 8 p

The DASH 8 is a 30 to 36 passenger high wing T tail STOL airliner powered by two turboprop engines driving hydromatic four bladed propellers with full blade angle control. The aircraft is designed to meet commercial market requirements in the passenger cargo, and executive transport roles with concentration on aero dynamic cleanliness to produce an energy efficient aircraft with low operating costs. The STOL criteria are related to requirements for a 3000 ft field length. A microprocessor was selected to perform the onboard data analysis task for the DASH 8. Attention is given to the basic instrumentation system, the microprocessor data stream interface data analysis by onboard computer and examples of onboard data analysis.

A82 13908 # Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers M J Burke and E W Ferris (Grumman Aerospace Corp., Calverton NY) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV, Nov 11 13 1981 AIAA Paper 81 2510 4 p

Pilot 'overshoot of the desired flight test conditions due to malfunctioning or inadequate cockpit displays has been a continuing problem. In addition monitoring multiple parameters during dy namic maneuvers is difficult for the pilot Structural flight testing utilizes indirect parameter ('g) for actual structural strain values resulting in poor predictability of strain values during a maneuver. A Microprocessor Crew Display (MCDS) was generated to meet this need. It consists of a 'bargraph' light emitting diode display two

CRT's and a caution/warning light. A total of five parameters can be selected and displayed at one time. Flight experience with the MCDS indicates more precise and quicker control of the aircraft, reduced probability of 'overshoot' increased flight safety and reduced flight test time.

(Author)

A82-13910 * # Direct strike lightning measurement system M E Thomas (NASA Langley Research Center Hampton VA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2513 8 p 6 refs

A research data system developed for in flight measurement of direct and nearby lightning-strike characteristics is described. The measurement system consists of a wide-band analog recorder which records the continuous lightning scenario and fast sample rate digital transient recorders with augmented memory capacity for increased time resolution of specific times of interest. Electromagnetic sensors with bandwidths exceeding 100 MHz are used which respond to rates of change of the quantities being measured. Data system immunity from electromagnetic interference is accomplished by the use of a dynamotor for power isolation, shielded system enclosure and fiber optic data links.

(Author)

A82 13911 # Instrumentation to determine the suitability of RNAV systems for helicopter navigation in the national airspace system /NAS/ J Gallagher and R D Till (FAA Technical Center Atlantic City NJ) A/AA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 A/AA Paper 81 2514 9 p 14 refs

This paper describes instrumentation developed and flight testing conducted by the Federal Aviation Administration (FAA) Technical Center to determine the suitability of RNAV systems for helicopter navigation A data collection package consisting of a militarized minicomputer interfaced to aircraft sensors and RNAV systems typically representative of LORAN C GPS Inertial Navigation and Omega was designed and fabricated A portable low cost position tracking system was devised for non precision approach navigation tests by Kalman filtering post flight position data derived from a pulsed radar ranging system with inertial and air data measurements resulting in improved position accuracy (Author)

A82 13913 * # Rotor systems research aircraft /RSRA/ rotor force and moment measurement system J S Burks (NASA Ames Research Center Moffett Field CA) AIAA, SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2516 12 p

The two Rotor Systems Research Aircraft (RSRA) are flight vehicles with unique measurement capabilities. The primary goal of the RSRA is direct measurement of rotor forces and moments in flight. This is accomplished through a rotor force and moment measurement system comprised of load cells and/or hydro pneumatic isolator units which are integral to the aircraft structure. Due to structural flexibility, the aircraft must undergo a physical calibration A static calibration of the first RSRA has been completed and data analysis has progressed through determination of a linear calibration algorithm. Design development and operation of the RSRA rotor force and moment measurement system and the Static Calibration Facility are described, and results of the calibration are presented.

(Author

A82 13916 # The Air Force Flight Test Center Utah Test and Training Range in the 1980 s C E Adolph (USAF Flight Test Center, Edwards AFB CA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2487 9 p

The Air Force Flight Test Center (AFFTC) conducts and supports manned and unmanned aircraft flight tests development testing of parachutes operates the Edwards Flight Test Range the USAF Test Pilot School and the Utah Test and Training Range This paper summarizes the evolutionary forces in the technical and management areas which gave impetus to today's methods of operation Current capabilities and procedures are then described followed by a discussion of improvements planned to meet the demands of the mid to late 1980's (Author)

A82 13917 # The need for, and development of a simula tion facility at the Naval Air Test Center B L Hildreth and A C Cruce (U S Navy Naval Air Test Center Patuxent River MD) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2488 9

Attention is given to the problem created by on the one hand rapidly rising test costs and on the other the increasing test requirements to satisfactorily evaluate systems of ever increasing complexity. A partial solution to this problem is to raise the productivity of the testing performed in terms of quantities of data gathered per dollar or per flight hour. Four benefits of a combined flight test/simulation program are cited improved safety increased productivity ability to test modern complex highly integrated systems, and the capability to test system performance against simulated threat environments. The requirements for a facility design based on these factors are discussed and the current progress of the Naval Air. Test Center toward developing a facility to meet these requirements is covered.

A82-13919 * # A unique integrated flight testing facility for advanced control/display research V M Batson J J Hatfield (NASA Langley Research Center, Hampton VA) and N E Novack (NASA Wallops Flight Center, Wallops Island VA) AIAA SETP SFTE SAE ITEA, and IEEE Flight Testing Conference, 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2490 11 p 13 refs

NASA is engaged in programs aimed at developing avionic concepts and systems technology for air transportation systems of the 1980's and beyond. A part of these programs is related to the development of advanced concepts and avionics technology for integrated displays and controls. In support of these efforts an interactive Flight Display Research System (FDRS) has been developed as an integral part of integrated flight test facilities which have been used in evaluation studies of integrated display and control concepts in support of a VTOL Approach and Landing Technology (VALT) program and current Terminal Configured Vehicle (TCV) program. A description is provided of several of the advanced integrated display and control concepts that have evolved within the VALT TCV and general aviation programs as well as the integrated flight test facilities.

A82 13921 # Collection and simulation of spatial infrared signatures of military jet aircraft W D Foster and H I Register (USAF, Eglin AFB, FL) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2494 6 p

The 3246th Test Wing at Eglin Air Force Base has developed airborne systems capable of collecting high resolution infrared data from ground and airborne targets. The beam approach seeker evaluation system includes test guidance units spatial scanners television cameras with missile track points and a laser ranger Infrared target simulation is designed to reproduce the infrared spatial data collected by the high resolution instrumentation system. The two approaches to this concept are the miniature filament approach and the thermochromics approach which uses VO2 S C S.

A82 13922 # Flight testing the suspended maneuvering system R K Svec (McDonnell Douglas Corp St Louis MO) AIAA, SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2498 8

The Suspended Maneuvering System (SMS) has been developed as a rapid response rescue vehicle that expands the capabilities and versatility of today's rescue methods Suspended from a helicopter the SMS is maneuvered horizontally by an onboard operator using an advanced thrust control system. This unique concept an adaptation of modern aerospace technology provides access to places considered inaccessible or hard to reach with conventional emergency equipment. Combating fires in high rise buildings is one major SMS application. The flight test program concentrated on tests at a simulated high rise building to develop the capability and techniques for docking' at windows and subsequent personnel entry and egress through the windows.

(Author)

A82 13924 # Improved techniques for the calibration and measurement of in flight loads K A Birk and R L Kuebrich (McDonnell Aircraft Co St Louis MO) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas, NV Nov 11 13 1981 AIAA Paper 81 2502 10 p

Techniques are presented for the calibration of strain gage bridge circuits installed in the F/A 18 wings. Methods are described which develop equations to solve for the traditional shear bending moment and torsional loads for a variety of flight conditions. The major improvements described are the use of zone loading techniques to enhance strain gage slope determination from the calibration loads the application of a family of flight equivalent distributed loads to better assess equation accuracy and the formulation of computer aided analysis techniques which allow review of larger volume of data while requiring fewer manhours. (Author)

A82-13928 # Overview of flight and ground testing with emphasis on the wind tunnel J D Whitefield (Sverdrup Technology Inc Tullahoma Calspan Field Services Inc Arnold Air Force Station TN) B J Griffith R W Butler (Calspan Field Services Inc Arnold Air Force Station TN) and C Bang (USAF Arnold Air Force Station TN) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2474 11 p 32 refs

A general overview of the development of (1) aircraft and missiles (2) the wind tunnel and (3) the emerging role of computational techniques is given Special comparisons between ground test data and flight data from aircraft space vehicles and reentry vehicles are made. The paper discusses some of the historical development of aircraft and ground testing with emphasis upon how computational fluid dynamic (CFD) techniques aid both the design and ground testing of flight vehicles. The speed regimes covered include low speed the transonic regime supersonic and reentry speeds. The methodology development made possible by the advent of CFD will be illustrated. Finally likely future trends in ground testing and CFD are discussed. The future role of ground testing and CFD in the development of aircraft and missiles in the 1980 s and 1990 s is assessed. (Author)

A82 13929 # F-4 Advanced Avionics Flight Test H A
Tracy (USAF Eglin AFB FL) AIAA SETP SFTE SAE ITEA and
IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13
1981 AIAA Paper 81 2464 6 p

Testing the integration of a new digital avionics navigation and weapon delivery system uncluding the interface with its sensors unto an aging aircraft with an analog system can be filled with problems During previous flight tests a 3/1 ratio of flown/productive flights was experienced. A current productivity rate approaching 100% can be related to pre mission testing of software and real time display of test data. Pre mission testing consists of loading the test software into a test simulator and performing simulated tasks to verify operation of the test software prior to loading it into an aircraft for flight. Real time display of test data is accomplished by inserting a software overlay into the airborne computer which outputs data to an external instrumentation pod where the data are recorded and transmitted via microwaves to the ground control facility. The displayed data include switch settings system errors ground track of the aircraft and software discretes (Author)

A82-13930 # F/A 18 high authority/high gain digital flight control system development and flight testing R A Burton and B T Kneeland Jr (U S Navy Naval Air Test Center Patuxent River, MD) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2465 8 p 6 refs

The F/A 18 airplane employs a fly by wire full authority/high gain digital flight control system (FCS) which at times can completely dominate aircraft response to pilot inputs resulting in higher order system responses that are a new and significant challenge for the flight test engineer to analyze This paper overviews the development of the F/A 18 digital FCS detailing changes to the programmable read only memory (PROM) flight control laws to correct flying qualities problems. In addition a summary of the advanced stability and control test techniques and data analysis

procedures used are presented and it is demonstrated how these techniques can quantify complex changes in flight control laws. These techniques consist of a maximum likelihood parameter identification program used to perform an equivalent system analysis. Data are presented which demonstrate the success the airframe contractor has had in reducing overall system equivalent time delays. (Author)

A82 13931 * # The development and flight test evaluation of an integrated propulsion control system for the HiMAT research airplane J L Baer Riedhart (NASA Flight Research Center Edwards AFB CA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2467 10 p 8 refs

The Highly Maneuverable Aircraft Technology airplane is a 44 scale version of an advanced fighter design. It is remotely piloted from a ground cockpit and is powered by a J85-GE 21 turbojet engine. The engine is electronically controlled by a digital computer onboard the airplane to operate at selected engine operation modes. The HiMAT design and development philosophy emphasized high risk low cost and minimum testing and also required that no single failure would cause loss of the vehicle. This philosophy generated unique requirements for design computer simulation methods specialized test techniques and support systems which are discussed in this paper.

A82 13936 # Comparison of low speed handling qualities in ground based and in flight simulator tests M F C van Gool (Nationaal Lucht en Ruimtevaarlaboratorium Amsterdam Nether lands) and N C Weingarten (Calspan Advanced Technology Center Buffalo NY) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2478 9 p 9 refs Research supported by the Nederlands Institut voor Vliegtuigontwikkeling en Ruimtevaart and Rijkslucht vaartdienst Contract No F33615-79-C 3618

Approaches and landings have been carried out using the Total In Flight Simulator (TIFS) to validate results of experiments on a ground based simulator in which handling qualities of transport aircraft equipped with advanced flight control systems were the subject of investigation. The configurations featured rate command/attitude hold in the pitch and roll axes. Variation of equivalent short period frequency pitch rate overshoot value of the normal acceleration sensitivity parameter direct lift control roll damping and roll time delay was studied. The results indicate that the ground based investigation predicted the outcome of the in flight experiments very well with the exception of the case with direct lift control in which objectionable normal accelerations were felt in flight that were not noticed during the ground based simulation.

(Author)

A82 13938 * # Powered lift STOL aircraft shipboard operations A comparison of simulation, land based and sea trial results for the OSRA V C Stevens D W Riddle J L Martin and R C Innis (NASA Ames Research Center Moffett Field CA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2480 16 p 10 refs

A moving base carrier landing flight simulation using NASA's Quiet Short Haul Research Aircraft (QSRA) was conducted during the design and fabrication of the QSRA After completing its initial flight testing the QSRA flew simulated carrier landings on land followed by actual carrier landings at sea. This paper compares the simulated flight characteristics used in the flight simulation (using an aircraft math model based on wind tunnel data) with the aircraft flight characteristics obtained from flight test data. This paper also compares the results of the QSRA flight simulation carrier landings the land based simulated carrier landings and the actual carrier landings. (Author)

A82 13939 * # A large-scale investigation of engine influence on inlet performance at angle-of attack B K Hodder B W Farquhar (Boeing Commercial Airlane Co Seattle WA) and M R Dudley (NASA Ames Research Center Moffett Field CA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2481 13 p 6 refs

A low speed wind tunnel test was conducted in the NASA/Ames 40×80 foot wind tunnel to investigate the effect of engine/inlet flowfield interaction on inlet performance near flow separation. The effect of engine/inlet flowfield interaction was determined by comparing the performance of a large scale subsonic inlet (CR = 1.26) close coupled and remote coupled to a TF 34 turbofan engine. The remote coupled inlet configuration removes the influence of the engine on the inlet flowfield and further typifies conventional small scale inlet test techniques which generally provide no simulation of turbomachinery effects. Test results indicated that engine interaction allows the inlet to operate with lower distortion levels at and beyond the separation angle of attack attained without engine interaction. (Author)

A82 13940 # Naval Weapons Center Test and evaluation in the 1980 s R V Boyd (U S Naval Weapons Center China Lake CA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2485 10 p

The Naval Weapons Center (NWC) at China Lake CA has test and evaluation missions that include strike weapons for land and sea targets air to air systems antiradiation missiles and antiship missile defense systems NWC facilities are outlined, noting current programs that comprise new warheads propulsion systems guidance and control units and missiles with extended range higher speeds and multiple target capability. Modernization efforts comprise an on axis data system a real time radar/optics system for precision space position velocity and acceleration measurements a metric video TV system a telemetry data acquisition system, upgraded range communication timing and control systems, and airspace surveillance system enhancement. A range control center centralized and technically current will provide direct support for weapons testing provide test data packaging and be able to support several simultaneous tests.

A82 13941 # Two at a time Flight test plans for the new Boeing airliners B S Wygle (Boeing Co Seattle WA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2378 5 p

Contracts regarding the sale of a new 200-passenger medium range airliner and a 170 passenger short to medium range airliner led to a situation in which the first airliner of one type is to be delivered in January 1983 about five months after delivery of the first aircraft of the other type. The flight test programs will substantially overlap during 1982 and create an unprecedented work level during that year. To manage the work load, the company has developed a flight test computer system and a training program for engineers. Remote test sites have been selected to provide good weather conditions and low traffic levels.

A82 13942 # Operational evaluation of the new generation of jet transport aircraft. C R Foster (FAA Seattle WA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981, AIAA Paper 81 2377 12 p

Within the Lead Region for Transport Aircraft the FAA is upgrading its capability for operational evaluation of the new generation of transport aircraft. The responsibilities of the Certification and Flight Standards Divisions are described with emphasis on the role of the FAA's Aircraft Evaluation Groups (AEG). The AEG's ensure that the necessary FAR 121. 91. 61 and other operating rules can be met by new aircraft at the time the aircraft enter line service. The AEG's also address aircraft operations policies described in FAA advisory material or ICAO standards for airport facility and ATC compatibility. Specific topics covered include the type rating training and maintenance programs minimum equipment lists crew workload and crew complement evaluation and continued operational support after entry into service.

A82 13944 # Flight test concept evolution L G Van Pelt (USAF Eglin AFB FL) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2375 11 p

A chronicle of progress in flight test philosophy is very revealing. Ever increasing emphasis has been placed upon the need

for flight test to be thorough and still meet the need for timely introduction of effective new aircraft into the operational inventory Major flight test concepts (Phase Testing Category Testing and Development Test and Evaluation/Operational Test and Evaluation) have been influenced by nuances such as concurrency fly before buy total package procurement prototyping competitive fly off etc. An understanding of these experiences and lessons learned will help in today's preparation of effective and efficient test programs (Author)

A82 13945 # Electro optical vector scoring system R
Rackauskas (U.S. Navy Pacific Missile Test Center Point Mugu CA)
AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2373 6

An electrooptical vector scoring system has been developed for miss distance scoring in fleet training exercises and for the testing and evaluation of weapon systems. The system utilizes solid state light emitting GaAs diodes which emit extremely short pulses of infrared radiation at 0.9 micron wavelength. The raw data obtained (range azimuth angle time) can be used to determine the relative velocity vector. A line drawn perpendicular to the relative velocity vector that passes through the center of the vector scoring system determines the miss distance. Score data is telemetered to a ground computer that computes velocity vector miss distance and the missile's attitude angle relative to the target.

A82 13946 * # The development and use of a computer interactive data acquisition and display system in a flight environment G A Bever (NASA Flight Research Center Edwards CA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11-13 1981 AIAA Paper 81 2371 16 p 6 refs

The flight test data requirements at the NASA Dryden Flight Research Center increased in complexity and more advanced instrumentation became necessary to accomplish mission goals. This paper describes the way in which an airborne computer was used to perform real time calculations on critical flight test parameters during a flight test on a winglet-equipped KC 135A aircraft. With the computer an airborne flight test engineer can select any sensor for airborne display in several formats including engineering units. The computer is able to not only calculate values derived from the sensor outputs but also to interact with the data acquisition system. It can change the data cycle format and data rate, and even insert the derived values into the pulse code modulation (PCM) bit stream for recording.

A82 13947 # Automatic digital gain ranging E G Hanson (Grumman Aerospace Corp Bethpage NY) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2370 5 p 13 refs

A logic circuit has been patented that automatically up scales and down scales digitized voice or data transmissions in response to variations in input amplitude. Although it was originally developed to compress flight test telemetry data the circuit can also be used advantageously in companding (data or voice compression and expansion) applications that are widely encountered in the communications industry. In this specialized application the circuit can be made to yield a close approximation to the 'mu law' characteristic which is an accepted standard in this country. Complementary logic circuitry will also be described for expanding compressed digital transmissions to their original linear digital form. (Author)

A82 13948 # The Advanced Range Instrumentation Aircraft improvement and modernization program J S Nash (USAF Systems Engineering Branch Wright Patterson AFB OH) A/AA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 A/AA Paper 81 2368 4 p

The Advanced Range Instrumentation Aircraft (ARIA) seven EC 135 aircraft configured for reception recording and real time relay of telemetry data are being retrofitted with new instrumentation to meet user's requirements for mobile telemetry collection and retransmission through the turn of the century Two sets of ARIA Prime Mission Electronic Equipment have been transferred to C 135B aircraft with TF 33 fan engines. Additional conversions will

utilize Boeing 707 320Cs Instrumentation changes include new recorders antennas antenna control systems feeds tracking systems and telemetry receivers (Author)

A82 13949 # Lockheed Airborne Data System Distributed microcomputers provide on board real time analysis J A Tabb (Lockheed Georgia Co Marietta GA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2367 9 p

This paper describes the more innovative features of the Lockheed Airborne Data System (LADS) and provides some insight into the high performance and cost effectiveness realizable by use of multiple processors in real time data systems. LADS uses multiprocessors in a highly distributed configuration to control verify process analyze and display data in real time on board the test aircraft. The approach is to use remotely located signal conditioner/multiplexer modules controlled in groups by distributed microcomputers which preprocess all incoming data. These microcomputers are synchronously controlled by a central data station which provides digital analog, video and graphics displays of which provides digital analog, video and graphics displays of the presonnel. The airborne system includes an integral analysis computer station with graphics and hard copy for real time analysis.

(Author)

A82 13955 # F/A 18 Flight Test program overview 1
September 1981 E R Shields (McDonnell Aircraft Co St Louis
MO) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing
Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper
81 2351 9 p

This report presents a F/A 18 Flight Test program overview including a discussion of pre-flight planning objectives. The flight envelope expansion program proceeded subsequent to first flight accumulating in excess of 2 600 flight hours in 24 months. Initial shipboard trials were completed successfully aboard the USS America. Navy/Marine pilot participation provided early customer inputs to the flight development process. Currently, the flight test program is nearing completion. Service Acceptance Trials and Navy Operational Evaluation are to be conducted during 1982. (Author)

A82 13956 # Navstar Global Positioning System flight test program overview A J MacMillan (Aerospace Corp. El Segundo CA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2350 9 p Contract No F04701 80 C 0081

The Navstar Global Positioning System (GPS) which is now in the full scale engineering development phase is discussed. An overview of the program including brief descriptions of the purpose of the program and of each of the three segments (space control and user equipment) is given. A description is also given of the test range at Yuma Proving Ground Arizona, including the real time laser tracking system. The development test and evaluation phase extending from 1977 to 1979 is described and some of the important results are presented.

A82 13962 # Development of a lifting parachute to provide self dispersing capability for an Avco designed tactical munition R J Kingsley (Avco Corp., Avco Systems Div Wilmington, MA) and J D Reuter (Pioneer Parachute Co Inc., Manchester CT) American Institute of Aeronautics and Astronautics Aerodynamic Decelerator and Balloon Technology Conference 7th, San Diego, CA Oct 21 23 1981 Pager 81 1928 9 p

This paper describes a program of analysis and test to develop a lifting parachute to provide ground dispersion for an assemblage of tactical munitions when air launched at low altitudes. A parachute lift to-drag ratio of 0.3 to 0.4 will provide acceptable pattern length and width Experiments were begun with parachutes of both ribbon and cruciform designs but unusual packaging restrictions eliminated the ribbon design. Full scale parachutes were first evaluated for low speed lift performance and then tested in a transonic wind tunnel. Free flight tests were performed with a stack of four munitions using a special rail launched booster rocket facility. The sequencing, or spacing of each munition in a stack is a critical factor.

in achieving optimum ground pattern and avoiding collision

Author

A82-13963 # Theoretical analysis of wake induced para chute collapse H R Spahr and D F Wolf (Sandia National Laboratory Albuquerque NM) American Institute of Aeronautics and Astronautics Aerodynamic Decelerator and Balloon Technology Conference 7th, San Diego CA, Oct 21 23 1981, Paper 81 1922 8 p 16 refs Research supported by the U S Department of Energy

During recent drop tests of a prototype weapon system the parachute collapsed soon after it became fully inflated. The magnitude and duration of the collapses were severe enough to degrade parachute performance drastically. A computer assisted analysis is presented which models parachute inflation forebody and parachute wake generation and interaction between the wake and the inflating or collapsing parachute. Comparison of the analysis results with full scale drop test results shows good agreement for two parachute sizes both parachutes were tested with and without permanent reefing. Computer generated graphics (black and white drawings color slides and color movies) show the forebody and inflating parachute the wake and the wake and parachute interaction. (Author)

A82 13966 # Escape systems decelerator technology D N
DeSimone (U.S. Naval Material Command Naval Air Development
Center Warminster PA) American Institute of Aeronautics and
Astronautics Aerodynamic Decelerator and Balloon Technology
Conference 7th, San Diego CA Oct 21 23 1981 Paper 81 1913 4

The development of escape system technology is considered taking into account initial ejection seat concepts during World War II safe parachute operation following escape from the aircraft fatality rates among ejectees and major modification programs during the mid to late 1960's Advances in military parachute technology are considered and technological problems associated with drogue stabilization parachutes are examined Attention is given to characteristics which are commonly encountered with today's escape system decelerator. There is found to be a need for advancements in the state of the art in escape system decelerator technology.

A82 13968 * # Modeling procedures for handling qualities evaluation of flexible aircraft K S Govindaraj B J Eulrich and C R Chalk (Calspan Advanced Technology Center Buffalo NY) Institute of Electrical and Electronics Engineers Annual Allerton Conference on Communication Control and Computing 19th Monticello IL Sept 30 Oct 2 1981 Paper 11 p NASA supported research Contract No F33615 79 C 3618

This paper presents simplified modeling procedures to evaluate the impact of flexible modes and the unsteady aerodynamic effects on the handling qualities of Supersonic Cruise Aircraft (SCR). The modeling procedures involve obtaining reduced order transfer function models of SCR vehicles including the important flexible mode responses and unsteady aerodynamic effects and conversion of the transfer function models to time domain equations for use in simulations. The use of the modeling procedures is illustrated by a simple example.

A82 13969 * # Aeroelasticity matters Some reflections on two decades of testing in the NASA Langley Transonic Dynamics Tunnel W H Reed III (NASA Langley Research Center Loads and Aeroelasticity Div Hampton VA) Deutsche Gesellschaft für Luft und Raumfahrt and Deutsche Forschungs und Versuchsanstalt für Luft und Raumfahrt International Symposium on Aeroelasticity Nurnberg West Germany Oct 5 7 1981 Paper 17 p. 47 refs

In 1955 work was started on the conversion of a subsonic wind tunnel to a 16 foot transonic tunnel with Freon 12 or air as the test medium. The new facility designated the Transonic Dynamics Tunnel (TDT) became fully operational in 1960. A description is presented of aeroelastic testing and research performed in the TDT since 1960. It is pointed out that wind tunnel tests of aeroelastic models require specialized experimental techniques seldom found in other types of wind tunnel studies. Attention is given to model

mount systems launch vehicle models aircraft models, aircraft buffet gust response stability derivative measurements and subcritical testing techniques. Aspects of vehicle development testing are considered along with aeroelastic fixes aeroelastic surprises approaches for controlling aeroelastic effects and unsteady pressure measurements.

A82 13971 * # The development of cryogenic wind tunnels and their application to maneuvering aircraft technology E C Polhamus and R P Boyden (NASA Langley Research Center Hampton VA) NATO AGARD Symposium on Combat Aircraft Maneuverability Florence Italy Oct 5 8 1981 Paper 13 p 20 refs

Cryogenic wind tunnels are considered as a means of studying high Reynolds number (Re) complicated flows encountered by high maneuvering lift and high angles of attack characteristic of modern fighter aircraft. Large decreases in the viscous force while the inertial force remains constant are provided by the use of cryogenic facilities. A 25 m square tunnel is nearing completion at the National Transonic Facility (NTF) and will be driven by synchronous motors having a total power of 120 000 hp. The tunnel using N2 as the cryogenic fluid will allow large Re sweeps at constant dynamic pressure and dynamic pressure and aeroelastic sweeps at constant Re full altitude (air density) and acceleration force simulation will also be possible. Advances in model and strain gage balance technologies for use at the NTF are outlined and experiments with buffet are described.

A82 13972 * # The integration of control and display concepts for improved pilot situational awareness L H Person Jr and G G Steinmetz (NASA Langley Research Center Hampton VA)
Flight Safety Foundation International Air Safety Seminar 34th
Acapulco Mexico Nov 9 12 1981 Paper 16 p

Consideration is given to a part of the Langley Terminal Configured Vehicle program in which the pilot is retained as an active segment of an integrated system. The pilot is active in the outer control loop and controls the orientation of the aircraft velocity. The pilot thus has a task but a low workload Attention is also given to first and second generation primary flight display for horizontal and vertical situation awareness.

A82 13973 * # Jet V/STOL wind tunnel simulation and groundplane effects R J Margason (NASA Langley Research Center Subsonic Aerodynamics Branch Hampton VA) NATO AGARD Symposium on Fluid Dynamics of Jets with Applications to V/STOL Lisbon Portugal Nov 25 1981 Paper 22 p 55 refs

Low speed wind tunnel testing of V/STOL aircraft concepts to determine the aerodynamic propulsion interaction effects during the transition between hover and wingborne flight is a necessary step in the development cycle of this type of aircraft Powered models are normally used to determine the aerodynamic performance character istics. This paper examines some of the pretest preparation necessary to define the objectives of an appropriate investigation. Several factors which influence the selection of the model concept and the engine simulator are discussed. In addition, some of the test techniques important for this class of aircraft model are examined. Finally, the paper reviews some of the wind tunnel wall effects important to this type of aircraft testing with special emphasis on groundplane effects.

A82 13974 * # Progress in aeronautical research and technology applicable to civil air transports R E Bower (NASA Langley Research Center Hampton VA) International Meeting on Transportation Research State of the Art Perspectives and International Cooperation Amalfy Italy Nov 11 14 1981 Paper 51 p

Recent progress in the aeronautical research and technology program being conducted by the United States National Aeronautics and Space Administration is discussed. Emphasis is on computational capability, new testing facilities drag reduction turbofan and turboprop propulsion noise composite materials active controls integrated avionics cockpit displays flight management, and operating problems. It is shown that this technology is significantly impacting the efficiency of the new civil air transports. The excitement of emerging research promises even greater benefits to future aircraft developments. (Author)

A82 13975 # Flight vibration optimization via conformal mapping F D Bartlett Jr (US Army Structures Laboratory Hampton VA) American Helicopter Society Northeast Region National Specialists Meeting on Helicopter Vibration Technology for Jet Smooth Ride Hartford CT Nov 2 4 1981 Paper 11 p 7 refs

An analytical approach based on the principle of conformal transformations is presented for evaluating the effects of structural dynamic changes on flight vibrations. Structural dynamic changes are characterized by discrete and multidimensional impedance adjust ments Discrete impedance changes such as point mass colinear stiffness and dynamic absorbers are emphasized to illustrate the practical aspects of the approach for flight vibration optimization Conformal mapping through inspections of complex plane response circles offers the capability for rapid evaluation of discrete imped ance change effects on flight vibrations. The operational equations require only baseline vibration data and impedance change dynamics Specific criteria for reducing vibrations are established using the response circle equations. In addition, the required impedance change to achieve minimum or zero vibration is uniquely defined Flight vibration optimization is illustrated using a remote absorber in conjunction with AH 1G helicopter ground and flight vibration measurements. Vibration reduction and absorber performance are assessed at several flight conditions and airframe stations

A82 13990 # A set of finite elements developed for the dynamic computation of composite helicopter blades L Simon (Societe Alkan Valenton Val de Marne ONERA Chatillion sous Bagneux Hauts de Seine France) (Institution of Mechanical Engineers National Engineering Laboratory and Paisley College of Technology International Conference on Composite Structures Paisley Scotland Sept 16 18 1981) ONERA TP no 1981 87 1981 16 p 10 refs

The paper proposes the creation of a set of finite elements for the computation of the eigenmodes of a helicopter rotor or airscrew blade made of composite materials in rotation or at rest. Isoparamet ric thick shell type elements are formulated to obtain degrees of freedom on the blade airfoil skeleton. The stiffness and consistent mass elements are presented to allow the computation of the eigenmodes of the clamped structure at rest, and the convenience of discretizing the terms of the variational formulation is demonstrated. Centrifugal effects giving a centrifugal stiffness element are used to determine the quasistatic equilibrium position, which can then determine the prestress due to spinning effects. Finally, the gyroscopic eigenvalue problem is developed, and numerical results are compared with experimental results for a tilt rotor blade aeroelastic model.

A82 13992 # Application of the ONERA dynamic stall model to a helicopter blade in forward flight C T Tran (ONERA Chatillon sous Bagneux Hauts de Seine France) and D Falchero (Societe Nationale Industrielle Aerospatiale Marignane Bouches du Rhone France) (Deutsche Gesellschaft für Luft und Raumfahrt European Rotorcraft and Powered Lift Aircraft Forum 7th Garmisch Partenkirchen West Germany Sept 8 11 1981) ONERA TP no 1981 89, 1981 26 p 12 refs

A single blade analysis for a helicopter rotor in hover and in forward flight is developed, which applies the unsteady aerodynamics of the ONERA two dimensional dynamic stall model. The stability of the aeroelastic system is studied by means of the Floquet theory and it is shown that the subharmonic oscillation and almost periodic oscillation of the Floquet modes can readily occur Periodic responses for the quasi-steady and unsteady calculations are compared and it is found that while the blade normal lift force distribution is insensitive to unsteady effects, the blade aerodynamic pitching moment and the torsional response are subjected to more influence of the unsteady aerodynamic pitching moment damping and time delay effects. It is concluded that the introduction of the blade flap and lead leg elastic deformations should present no difficulty in principle by a modal superposition of the blade's normal modes DLG

A82 13993 # Development of an MLS lateral autoland system with automatic path definition A A Lambregts (Boeing

Commercial Airplane Co Seattle WA) American Institute of Aeronautics and Astronautics Guidance and Control Conference Albuquerque NM Aug 19 21 1981 Paper 81 1751 8 p 5 refs

The new Microwave Landing System will provide extended aircraft guidance capability in the terminal area. To utilize this capability effectively requires that the approach path be defined. This paper describes the development and simulator evaluation of an MLS lateral autoland control algorithm using automatic path definition. The algorithm connects the initial approach path to the extended runway centerline using straight and constant radius turn segments. The path is executed by a linear track and a novel circular turn control law to capture a straight track using MLS azimuth and DME signals. The algorithm eliminates maneuver transients when switching to MLS guidance and avoids external path definition inputs. (Author)

A82 14042 Aircraft absorbers Promise and practice A
O Andersson (Boeing Commercial Airplane Co Seattle WA)
Acoustical Society of America Meeting 101st Ottawa Canada May
18 22 1981 Paper 21 p

Attention is given to the application of sound absorbers to aircraft engine ducts. Fan duct application is discussed with reference to the frequency spectrum of fan noise, the wave number spectrum of fan noise and both local and extended reactions to lining types. The design of duct linings is examined noting a number of analysis techniques for non uniform ducts and linings. The impedence meter is considered for non destructive testing of curved lining panels and possibilities for mode measurements for lining design are reviewed.

202

A82 14043 Impedance modeling of acoustic absorbing materials for aircraft engine applications L W Dean III (United Technologies Corp Commercial Products Div East Hartford CT) and W P Patrick (United Technologies Research Center East Hartford CT) Acoustical Society of America Meeting 101st Ottawa Canada May 18 22 1981 Paper 51 p 65 refs

A review of conditions under which impedance is a useful concept in solving the problem of wave propagation in a duct with flow is presented with illustrative examples. Organized procedures for modeling single and multiple degree of freedom configurations both of the lumped and distributed parameter type are discussed and data and model predictions are compared for some specific configurations. Assumptions usually made in the modeling process are pointed out and the effect of the assumptions particularly on the comparisons with data are evaluated improved impedance models developed more recently are reviewed and compared with previous models and with impedance tube data. Included in the discussion are models for bulk absorber materials compatible with aircraft engine environments. (Author)

 A82 14354
 Fighters
 Improving the breed
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 Warwick

 Flight International
 vol
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Performance capability gains are projected in light of structural and weapon system modifications to the F 15 and F 16 aircraft. The conversion of the F 16 to the F 16E variant entails the addition of two fuselage plugs that lengthen the fuselage by 56 in and the bolting on of a double delta wing having 120% greater area than the present one. Together, these modifications increase internal fuel capacity by 82% representing 124% greater range for the same payload. Attention is also given the staged development and retrofit of day/night, all weather air defense and ground attack. F 16 electronics. The modifications contemplated for the F 15E two seat variant include synthetic aperture radar (SAR) and a rear cockpit equipped with CRT displays for radar forward looking infrared (FLIR), threat warning and a computer generated tactical map. O.C.

A82 14363 Trim tab excitation system for the BAe 146 P Lawson (Cranfield Institute of Technology Cranfield Beds England) Aircraft Engineering vol 53 Oct 1981, p 12

An account is given of the design of an aileron and elevator trim tab controlled excitation system which would assist in BAe 146 control surface flight clearance trials. For the flutter trials to be valid it was necessary to devise an excitation system which would fit into wing and tailplane structures without their modification. In

order to provide an effective fail safe system against electrical or hydraulic failure the trim tab centralizing mechanism exceeds the actuator stall load by more than 2.1 which in the case of the elevator requires about 5.000 lbs of axial thrust. The mechanism employed comprises a spring-loaded toggle linkage operating a wedge into the side of the main actuator piston. Bench tests show an adequate system response over the 1.60 Hz frequency range required

A82 14364 The protection of gas turbine blades A platinum aluminide diffusion coating. R G Wing (Rolls Royce Ltd Leavesden Herts England) and I R McGill Aircraft Engineering vol 53 Oct 1981, p 15 21 17 refs

The combination of high turbine operating temperatures and the presence of ingested sulphate and chloride salts in the marine environments in which ships hovercraft and helicopters operate can lead to the costly hot corrosion of turbine blades. A discussion is presented of the use of platinum aluminide coatings to protect super alloy turbine blades from both oxidation and hot corrosion with greater effectiveness than nickel aluminide diffusion coatings Because of the problems of poor adherence, high porosity and hardness associated with the use of electroplating in the application of the initial platinum coating to nickel based super alloy blades a fused salt platinum deposition process has been developed. The aluminizing of this base layer is conducted at temperatures below 800 C yielding a 50 micron platinum aluminide layer of which only the outer two microns are pure with greater depths containing a beta nickel aluminum intermetallic. Burner rig test results in which contaminants representative of marine environment conditions are reported for the cases of two coatings produced by the new deposition method JML 1 and 2

A82 14365 Attack on superalloys by chemical and electro lytic processes H Simon and M Thoma Aircraft Engineering vol 53 Oct 1981, p 22 25

In the course of such turbine aircraft engine production and overhaul surface treatment processes as electrolytic degreasing chemical and electrochemical etching chemical descaling and chemi cal stripping of thermally sprayed coatings the precipitation hardened nickel and cobalt base alloys of the highest temperature turbine elements are subjected to corrosion. This effect is due to the carbide nitride and carbonitride intermetallics formed by alloying elements added for precipitation hardening, which appear as inclu sions of various shapes and sizes within the grain or at the grain boundaries. It is shown that these intermetallics present as separate phases, can be dissolved out by oxidative attack Backscattered electron and X ray analyses of seven nickel and cobalt base materials lead to the conclusion that certain processes or process steps cannot be employed in production and overhaul and alternative processing methods are suggested O C

A82 14376 # Status and tracking system for flight test data products R Large W May and D O Keefe (USAF Flight Test Center, Edwards AFB CA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2395 13 p

A flight test data product status and tracking (SANDT) system has been developed and used by the Air Force Flight Test Center Initially used in support of the Air Launched Cruise Missile Program the SANDT has recently been applied to F 15 testing The SANDT makes use of System 2000 Data Base Software on the Center's CDC CYBER 74 scientific computer. The paper will discuss the requirements design alternatives resource use, and operating experience to date. Results include improved data support planning flexibility in supporting dissimilar flight test program and integration of data processing with status reporting. (Author)

A82 14377 # An advanced facility for processing aircraft dynamic test data D J Stouder (Douglas Aircraft Co Long Beach CA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2398 10 p

Capabilities of the Acoustics and Vibration Data Center (AVDC) are described using examples from various flight and laboratory tests related to commercial and military jet transports. Features such as

the one third octave band spectrum analysis and the narrow band spectrum analysis which were developed to derive noise intensity and annoyance parameters are discussed. The paired signal analysis for studying input output problems and audio presentation are also described. In addition, future developments are summarized, including the integration of the AVDC with the main flight test data processing facility.

A82 14379 * # Experience with flight test trajectory guid ance M R Swann E L Duke E K Enevoidson and T D Wolf (NASA, Flight Research Center, Edwards CA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st, Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2504 8 p 5 refs

A system that provides the test pilot with flight test trajectory guidance is presently evolving at the NASA Dryden Flight Research Facility. In use, this system has resulted in discernible improvements in the ease and accuracy with which pilots have approached and maintained the desired flight test conditions or trajectories. This paper describes the use of the guidance system in several past flight programs at Dryden including the F. 111 TACT program the F. 15 airframe/propulsion system interaction program, the F. 15 cone transition and boundary layer experiments, and the Space Shuttle tiles flight test program. (Author)

A82 14380 # Pave Mover Flight Test Program D E Holberg and J F Grabowsky (Hughes Aircraft Co Los Angeles CA) AIAA, SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13, 1981 AIAA Paper 81 2492 11 p USAF DARPA sponsored research

Pave Mover is an Advanced Development Model Program performed by Hughes Aircraft Company and sponsored by the Rome Air Development Center and DARPA it is currently under test at White Sands Missile Range New Mexico The system consists of an F 111E aircraft carrying a long range MTI/SAR radar and a ground based data processing and control system connected by a two way Sperry data link Pave Mover is the radar portion of the DARPA conceived Assault Breaker concept demonstration designed to counter a massive attack of tank forces by radar updated surface to surface missiles equipped with anti-tank submunitions. During the demonstration it is also intended to track and guide air to surface missiles and manned attack aircraft. After a brief system description the paper discusses flight test aspects such as aircraft modification, the removable radar/pallet design simulated targets remotely con trolled tank targets missile simulation using an F4 aircraft the accuracy reference instrumentation and various software simulators used in preparation for the tests

A82 14381 * # In flight deflection measurement of the HiMAT aeroelastically tailored wing V M DeAngelis (NASA Ames Research Center Edwards CA) AIAA SETP SFTE, SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2450 11 p

An electro optical flight deflection measurement system was developed for NASA for use on the highly maneuverable aircraft technology (HiMAT) remotely piloted research vehicle (RPRV) to provide a means of evaluating the performance of the HiMAT's aeroelastically tailored composite wing and canard. A description of the flight deflection measurement system is presented from a user's viewpoint and includes the general method of operation system capabilities and limitations method of installation on the HiMAT vehicle and calibration of targets. Also included is a general description of the HiMAT RPRV and its design goals. Preliminary flight deflection and bending moment data were obtained at Mach 0.8 and were extrapolated to the Mach 0.9 maneuver design condition for comparison to NASTRAN predictions and ground loads test results. The preliminary flight test results tended to agree with the results obtained from the static ground loads tests, that is that the NASTRAN model overpredicted the streamwise twist of the composite outer wing panel (Author)

A82 14382 * # A review of flight to-wind tunnel drag correla tion E J Saltzman and T G Ayers (NASA Flight Research Center, Edwards CA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2475 19 p 46 refs

Comparisons are made of wind-tunnel model and flight drag

data for various configurations representing aircraft from the mid 1940s to the 1970s Discrepancies between model and flight data such as Reynolds number effects wall interference, and aeroelastic problems are discussed String support effects and the inability of models to simulate surface deflections for longitudinal trim are also studied. A wind tunnel to flight correlation of turbulent friction drag confirms the incompressible Karman Schoenherr variation of turbulent skin friction with Reynolds number and the T method for accounting compressibility effects. NASA tested 10 degione research indicates that model tests which are affected by tunnel noise may require the lower disturbance level environment available in flight and it is concluded that new cryogenic facilities will improve the fidelity of model simulations of full scale flight flow phenomena.

A82 14383 * # Techniques for modifying airfoils and fairings on aircraft using foam and fiberglass M B Meyer (NASA Flight Research Center Edwards, CA) and F Jiran (Fred Jiran Glider Repairs, Mojave, CA) AIAA SETP, SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2445 15 p 5 refs

The concept of using foam and fiberglass reinforced plastic to modify airfoils and fairings was applied successfully to high speed aircraft at NASA Dryden Flight Research Center. An on aircraft installation method was used to modify an F.15 wing glove and wing leading edge and an F.104 flap trailing edge in support of the Shuttle leairload tests. A combination of methods, both an on aircraft installation and an off aircraft fabrication for installation on the aircraft was used to modify a section of an F.111 supercritical wing with a natural laminar flow airfoil. Techniques methods, problem areas and recommendations are presented which indicate that using foam and fiberglass to modify airfoils and fairings on high speed aircraft is a viable means of quickly developing airfoils and fairings with desired aerodynamic characteristics with little risk to the parent or carrier aircraft. (Author)

A82 14384 # KC-10, flight test program management The contractor's viewpoint J L Cook (Douglas Aircraft Co Long Beach CA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2380 4 p

The management of a flight test program for the KC 10 aerial refueling tanker aircraft which included elements of development FAA certification and Air Force qualification and operational testing is described in addition to the manufacturer and the FAA the participants included the Joint AFLC/AFCS Program Office (JPO), the Air Force Primary Test Organization and the Air Force Test and Evaluation Center. The flight test program involved not only tanker and receiver aircraft qualifications and operational evaluations but also air crew training ground crew training tech order validation, maintainability demonstrations human factors tests support equipment compatibility validations cargo loading demonstrations and acceptance test procedure validations. It was found that a division of authority between the Air Force and the FAA was highly effective and that parallel rather than series development testing is essential to efficient test programs.

A82 14385 # 62% manned aircraft demonstrator Next generation trainer W H Shawler (Fairchild Republic Co Fairming dale, NY) AIAA SETP, SFTE SAE 'TEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2519 8 p

A manned 62% scale aircraft demonstrator designed for the Air Force's next generation trainer program is reported. Areas investigated include basic handling qualities hinge moments on the flight control surfaces vertical and horizontal tail loads and spin characteristics. Results of the program are compared with wind tunnel results and scaling effects and show good agreement with the previous data for features such as flap lift increment aileron and rudder effectiveness and the maximum lift coefficient. It is concluded that the 62% scale flight tests are accurate and the concept can be used for new programs such as the NGT at a greatly reduced cost.

A82 14386 # Hover tests of the XV 15 Tilt Rotor Research
Aircraft. M D Maisel (US Army Research and Technology

Laboratories Moffett Field CA) and D J Harris (U.S. Navy Naval Air Test Center Patuxent River MD) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13, 1981 AIAA Paper 81 2501 13 p 5 refs

A series of tests was conducted to investigate the hovering characteristics of the XV 15 Tilt Rotor Research Aircraft Various wheel heights were flown to examine the effects of ground proximity. In addition to free hover, the aircraft was operated on a tie down facility that provided a 18 m (6 ft) wheel height condition. Data were obtained for hover performance both in and out of ground effect downwash phenomena handling characteristics as a function of hover height, and acoustics around the hovering aircraft. The results show that the XV 15 is efficient in hover and that increased control activity is required as the aircraft approaches the ground. Downwash velocities are moderate at the sides of the aircraft and relatively high fore and aft. The acoustics evaluation revealed moderate noise levels with an acceptable sound quality. (Author)

A82 14387 # Testing capabilities of the 3246th Test Wing
D H Williams Jr (USAF Eglin AFB FL) AIAA SETP SFTE
SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas
NV Nov 11 13 1981 AIAA Paper 81 2484 7 p

The capabilities of the 3246th Test Wing at Eglin Air Force Base are reviewed and developmental non nuclear air armament systems and components are evaluated. The Wing's geographic location with respect to major population centers current testing capabilities existing instrumentation facilities and plans for expanding the air to surface air to air and electromagnetic capabilities are discussed. Typical missions using the multiobject tracking ranging and control system are presented, and the seeker evaluation test system and the preflight integration of munitions and electronics systems are reported. Other future programs are discussed which include increasingly sophisticated all weather weapons with significantly improved multiple kill per pass hit probabilities.

A82-14389 # Integrated flight testing based on nonlinear system identification data processing techniques J H Vincent and S N Franklin (Systems Control Technology Inc. Palo Alto CA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2449 11 p 7 refs Contract No N00014 78 C 0641

The results presented in this paper demonstrate the operational status of nonlinear system identification data processing techniques. Aerodynamic installed thrust and flight test instrumentation call bration models are identified for the F.4S from six different flight conditions which encompass a large range in angle of attack sideslip airspeed control inputs and body rotation rates. The capability for identifying nonlinear aerodynamic models in a format compatible with preflight predictions is demonstrated. A methodology for determining the accuracy of the parameters estimates is presented.

(Author)

A82 14390 * # AD 1 oblique wing aircraft program T C McMurtry A G Sim and W H Andrews (NASA Flight Research Center Edwards CA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81-2354 7 p

A NASA program for evaluation of the handling and flying characteristics of the AD 1 oblique wing aircraft is discussed. The vehicle was flown to compare wind tunnel predictions with aero dynamic data explore the control system requirements and obtain a preliminary assessment of the aeroelastic effects. The fiberglass sandwich skin aircraft is designed for 8 g positive and 4 g negative loading at 175 knots while the wing pivot can withstand 25 g loading. Flight monitoring was accomplished with a 41 channel pulse code modulation system for telemetry and by averaging of pilot ratings. Maneuvering tests are outlined noting that pilot ratings indicated acceptable handling at up to 50 deg sweep. It is concluded that acceptable flying qualities can be achieved with a 60 deg sweep and that aeroelastic tailoring can be used to satisfy cruise design technology.

A82 14392 * # The use of frequency methods in rotorcraft system identification R W DuVal (NASA Ames Research Center Moffett Field CA) A/AA SETP SFTE SAE ITEA, and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981

AIAA Paper 81 2386 9 p

A new approach to model structure determination is examined Flight data from the Rotor Systems Research Aircraft (RSRA) are transformed into the frequency domain and truncated to provide band limiting. The stepwise regression technique is then used to identify a quasistatic state space model from the transformed data. The data processing requirements for both time domain and frequency domain identification are discussed and the results of the two techniques are compared. (Author)

A82 14393 * # Comparison of wind tunnel and theoretical aeroelastic predictions with flight measured airloads for the B-1 aircraft. R L Sims and A L Carter (NASA Flight Research Center Edwards CA) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2387 15 p 13 refs

An aeroelastic analysis of the B1 aircraft was generated using the FLEXSTAB computer program Relatively simple aerodynamic and structural models were employed. Theoretical wing and hori zontal stabilizer airloads were compared to wind tunnel predictions and flight data measured during quasi steady pitch maneuvers at Mach numbers of 0 85 and 1 2 with the wing in the 67 5 degree full aft sweep position. The basic objective was to evaluate the usefulness of the FLEXSTAB program for pre flight airloads analysis of large flexible aircraft Significant aeroelastic increments were noted between rigid and flexible vehicle results. FLEXSTAB predicted airloads for the outer wing panel were in good agreement with measured data for both rigid airloads and elastic increments FLEXSTAB results for the horizontal stabilizer were useful for defining general aeroelastic trends but absolute load levels were not well predicted due to theoretical limitations and difficulties en countered in modelling the complex B 1 configuration. Overall, the FLEXSTAB program is viewed as a useful integrated tool for static aeroelastic analysis in support of flight programs (Author)

A82 14398 # Advanced fighter technology integration AFTI/F 16 test program overview R A Gill and C L Saint Sauver (USAF Wright Aeronautical Laboratories Wright Patterson AFB OH) AIAA SETP SFTE SAE ITEA and IEEE Flight Testing Conference 1st Las Vegas NV Nov 11 13 1981 AIAA Paper 81 2353 17 p

The AFTI/F 16 Advanced Development Program objective is to develop integrate and validate advanced fighter technologies to improve air to air and air to surface weapon delivery and survivability. The technologies include a Digital Flight Control System Integrated Flight/Fire Control pilot/vehicle interface advancements and advanced flight control modes through direct force control and weapon line pointing. Extensive modifications were made to an F. 16A for installation of a data instrumentation system modified inlet with canards and a dorsal fairing. The AFTI/F 16 is undergoing an extensive test program to provide the confidence necessary to transition the new technologies for retrofit into existing aircraft or incorporation into new fighter aircraft designs.

A82 14407 * Development of a comprehensive analysis for rotorcraft II Aircraft model solution procedure and applications W Johnson (NASA Ames Research Center US Army Aero mechanics Laboratory Moffett Field CA) Vertica vol 5 no 3 1981 p 185 216 15 refs

The development of a comprehensive analytical model of rotorcraft aerodynamics and dynamics is described. Particular emphasis is given to describing the reasons behind the choices and decisions involved in constructing the model. The analysis is designed to calculate rotor performance loads and noise helicopter vibration and gust response flight dynamics and handling qualities and system aeroelastic stability. It is intended for use in the design testing and evaluation of a wide class of rotors and rotorcraft and to be the basis for further development of rotary wing theories. The general characteristics of the geometric structural inertial and aerodynamic models used for the rotorcraft components are described including the assumptions introduced by the chosen models and the resulting capabilities and limitations. Finally some examples from recent applications of the analysis are given.

(Author)

A82 14414 The operational characteristics of turbojets, giving particular attention to the cooled high pressure turbine (Zum Betriebsverhalten von Turbolufstrahlantrieben unter besonderer Benucksichtigung der gekühlten Hochdruckturbine) W Muggli (Munchen Technische Universität Munich West Germany) Zeit schrift für Flugwissenschaften und Weltraumforschung vol 5 Sept Oct. 1981 p. 273 283 6 refs In German

The employment of a gas turbine has great advantages for aircraft provided high operational temperatures and pressures can be used. In connection with the current status of technology concerning materials, it is necessary to cool engine components exposed to the hot gases. The consideration of the cooling processes is an important factor in the determination of the local flow conditions in the blading area of a turbonat hine is considered and a description is presented of the computational procedures for determining the amount of heat transferred at a cooled blade of the turbine. The determination of the amount of air needed for cooling is discussed along with the numerical calculation of the operational characteristics of cooled axial turbines. Attention is given to a number of approaches for reducing the amount of air required for cooling in a high-pressure turbine.

G. R.

A82 14416 Wing design for light transport aircraft with improved fuel economy D Welte R Birrenbach and W Haberland (Dornier GmbH Friedrichshafen West Germany) Zeitschrift für Flugwissenschaften und Weltraumforschung vol 5 Sept Oct 1981 p 294 303 5 refs Research supported by the Bundesministerium für Forschung und Technologie

Investigations related to the development of a new wing for a light transport aircraft were initiated by a German aerospace company in 1975. Flight tests for the evaluation of the new wing began in June 1979. The considered design incorporates a new wing section and a wing tip having a triangular shape. The induced drag observed in connection with the new wing tip is less than the corresponding value found for wing tips of conventional design Tradeoff studies were conducted to optimize wing area and wing aspect ratio for the specified performance requirements. A use of the new wing design makes it possible to obtain aircraft with high maximum lift values low drag and good stall characteristics. Attention is given to the wing parameter study aspects of airfoil design the flap design the wing design the aircroal and the inents of a number of different wing structures.

A82 14418 The load carrying behavior of a trapezoidal aluminum alloy supporting element subjected to a compressive stress in the postbuckling region (Das Tragverhalten eines gedruckten Alu Trapeztragers im Nachbeulbereich) E Schneider (Vereinigte Flugtechnische Werke GmbH Bremen West Germany) Zeitschrift für Flugwissenschaften und Weltraumforschung vol 5 Sept Oct 1981 p 313 323 8 refs In German Research supported by the Bundesministerium der Verteidigung

An analysis is conducted of the behavior of a trapezoidal aluminum-alloy supporting element which is subjected to a compressive force taking into consideration before and after the force reaches the value of the carrying capacity. The analysis makes use of the finite element method and takes into account geometrical nonlinearities and the elastic plastic material characteristics of aluminum. It is found that the behavior of the supporting element in the postbuckling region can be determined with the aid of the slow ramp method a dynamic computational procedure. The magnitude of the considered system damping and the deformation rate selected for the computation are found to have a significant effect on the result. A comparison of computed and experimental data shows that it is possible to predict the behavior of the supporting element analytically with satisfactory accuracy.

A82 14676

NAECON 1981, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-21 1981 Volumes 1 2 & 3 Conference sponsored by the Institute of Electrical and Electronics Engineers New York Institute of Electrical and Electronics Engineers Inc. 1981 Vol. 1 460 p. vol. 2 495 p. vol. 3 502 p. Price of three volumes members \$45 nonmem bers \$60

Topics of aerospace electronics such as the ADA programming

language, inertial systems microcomputer applications survivability and the all electric aircraft were discussed. Papers were presented on laser gyros and advanced navigation systems as well as advanced architecture communications, and radar equipment software and avionics and armament planning. Failures in high voltage tubes were considered and attention was given to signal processing techniques, integrated aircraft controls, fire control software support tools cost estimates for software and medical technology. Emphases were placed on Kalman filter an electronic terrain map. EM compatibility aerospace power systems, air traffic control environmental stress measurements fault isolation and multivariable flight control design.

A82-14678

The design and implementation of a canned scenario function for the F 16 dynamic system simulator L Gearhart (Lear Siegler Inc., Astronics Div Dayton OH) and D L Dresel (TRW Defense and Space Systems Group, Dayton, OH) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19 21 1981 Volume 1 New York, Institute of Electrical and Electronics Engineers Inc. 1981, p. 10 17

The F 16 Dynamic System Simulator (DSS) is an integrated hardware and software system used to test the F 16 Operational Flight Program (OFP) A major function of DSS is its Canned Scenario the generation of repeatable scenarios for demonstrations and for the verification and validation of the F 16 OFP Develop ment of a canned scenario requires the classification of the dynamic characteristics of the system the inputs outputs, plant and system states Analysis of the system being simulated is paralleled by an analysis of the simulation models. The interfaces and models are grouped in blocks according to such characteristics as random or asynchronous versus deterministic behavior. An appropriate set of inputs and initial states is defined for the canned scenario function based on the user's needs. These initial and input variable sets are incorporated into the software design of the canned scenario and can be recorded and played back in order to repeat the essential behavior of the system. The scenario is applied to the F 16 OFP as an example and problems encountered in its implementation are discussed

A82 14682 Strapdown inertial reference systems performance analysis G J Robinette (USAF Avionics Laboratory, Wright Patterson AFB, OH) R C Burns, and R M Schwarz (McDonnell Aircraft Co Avionics Engineering Div St Louis MO) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference, Dayton OH, May 19 21, 1981 Volume 1

New York Institute of Electrical and Electronics Engineers, Inc. 1981, p 38 45 7 refs

The Strapdown Performance Study (SPS) program is being sponsored by the Air Force Wright Aeronautical Laboratories to determine where improvements in strapdown inertial technology are required to meet the tactical and strategic navigation and weapon delivery requirements associated with advanced tactical fighters (ATF) and advanced cruise missiles (ACM) of the 1990's Phase I of this study includes the gathering of data, the development of simulation tools and the methodology for validation of these tools Data were gathered on current inertial instruments and systems, fundamental performance limitations and projected instrument capabilities. Mission profiles for the ATF and ACM are used as the basis for establishing performance goals. Strapdown inertial system implementation data were used to establish a preliminary inertial system error budget consistent with ATF/ACM performance goals. A SIMulated Strapdown Inertial Navigation (SIMSIN) computer program, its development and seven step validation process are described JF

A82 14684 A failure detection and isolation system for tactical aircraft with separated IMUs P Motyka (Charles Stark Draper Laboratory Inc Cambridge MA) in NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21, 1981 Volume 1 New York, Institute of Electrical and Electronics Engineers, Inc 1981, p 51 60 7 refs Contract No F33615 78 C 1563

The development and evaluation of a failure detection and isolation (FDI) system for tactical aircraft with two physically

separated inertial measurement units (IMUs) are described. Each IMU consists of four inertial instruments in a symmetrical conical array. The instrument outputs are used for both navigation and flight control reflecting the underlying multifunction inertial reference assembly concept. FID is performed using the generalized likelihood test, and the thresholds required for FDI are defined. Digital simulation results are presented which show the operation of the FDI system over a spectrum of sensor failures and indicate the effects of these failures on navigation errors. Results show that it may be feasible to detect and isolate only the first three failures of the dual IMU system. Lever arm compensation results in the faster detection of accelerometer failures at the expense of increased computer throughput. Finally, failures of a magnitude less than the soft failure detection threshold are more likely to be isolated incorrectly.

A82 14685

A concept for a high accuracy, low cost accelerometer S G Shutt (Rockwell International Corp Autonetics Div Anaheim CA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH, May 19 21 1981 Volume 1 New York Institute of Electrical and Electronics Engineers, Inc. 1981 p. 61 69

A three axis accelerometer is described in which low cross coupling between axes is achieved by a novel electromagnetic forcing system A mechanical proof mass support system is used which has small bias variation in the presence of large parts instabilities, compared to the usual inertial instruments. This accelerometer concept has the potential for low cost and high accuracy operation over a wide temperature range. An experimental accelerometer was designed built and tested to determine the feasibility of the accelerometer concept. The main components of this accelerometer are described first (1) housing and magnet assembly (2) proof mass assembly, (3) pickoff assembly and (4) filament support system Data were obtained for the spring rates the bias and scale factor coupling coefficients the bias instability, and the bias temperature sensitivity. All measured parameters were within acceptable calculat ed values overall operation of the experimental accelerometer was found to be successful

A82 14694 High-accuracy ranging over voice radios for downed aircrew rescue R H Brader (RCA, Government Communications Systems Div Camden NJ) in NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH, May 19 21, 1981 Volume 1 New York Institute of Electrical and Electronics Engineers Inc 1981, p 128 133

A high accuracy ranging technique using digital technology and LSI implementation has transformed a conventional military survival walkie talkie into a position location system that helps rescue downed pilots. This paper first describes the operational requirements and scenario for a military downed aircrew rescue. The basic technique involved in a half duplex ranging system and the specific techniques developed to meet the operational requirements and voice radio constraints are then discussed in some detail. The problems discussed are efficient modulations in an AM radio, delay variation control, rapid acquisition using a narrow bandwidth radio memory requirements for half duplex operation and digital design for miniaturization.

A82 14696 High speed microwave phase-locked loops E M Perdue (Raytheon Communication Systems Laboratory Sudbury

M Perdue (Raytheon Communication Systems Laboratory Sudbury MA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 1

New York Institute of Electrical and Electronics
Engineers Inc 1981 p 140 145 9 refs Research sponsored by the
Raytheon Co Contracts No F33615-73 C-4036 No
F33615-78 C 1583

A microwave synthesizer scheme is developed which can embody rapid broadband tuning accuracy and resolution for instituting Doppler correction, spectral purity for low data rate transmission remote control and small size for airborne operations. The scheme is directly adaptable to any band of communication while providing secure antijamming techniques and the microwave phase locked loop can control and produce an output with excellent phase noise characteristics with spurious levels below 60 dBc at any

Point in the band. The phase locked synthesizer also meets present switching speed requirements.

A82-14705 Electromechanical actuation development program S A Rowe (AiResearch Manufacturing Company of Califor nia Torrance CA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21, 1981 Volume 1 New York Institute of Electrical and Electronics Engineers Inc. 1981 p 206-213 12 refs

A prototype electromechanical actuation system (EMAS) development program for aircraft flight control systems (FCS) was initiated in February 1976 resulting in a working prototype actuation system suitable for aircraft primary FCS applications. Tests involving EMAS components performance environment and control/stability are reported and program motivation EMAS description and nomenclature program history and future objectives are discussed.

A82 14707 Will power by wire replace power-by hydraulics 1 S Mehdi (Boeing Military Airplane Co., Seattle, WA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 1

New York Institute of Electrical and Electronics Engineers Inc. 1981 p. 221 228 8 refs

The development of two parallel aircraft actuation and secon dary power systems designed within the context of a two engined fighter is discussed. One is based on engine extracted hydraulic power while the other is based on engine extracted electric power. Consideration is given to actuation system requirements gun and environmental control system requirements secondary power system requirements and temperature parameters. Preliminary results are presented for estimates of weights and life cycle costs for each system. Factors important for achieving an all electric airplane are identified.

A82 14709 The all electric airplane Its development and logistic support. M J Cronin (Lockheed California Co Burbank CA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton, OH, May 19 21 1981 Volume 1 New York Institute of Electrical and Electronics Engineers, Inc. 1981 p. 241 247 19 refs

Developmental and logistic support aspects that must be considered as a part of the development cycle of potentially large electric power systems are reviewed. Increasing fuel problems and their impact on the economic viability of commercial airlines are discussed. The hardware design power generation system environ mental control system and the engine starting system are also discussed. In addition, the impact of these large electric power systems on ground logistic support and operation from ground power units, auxiliary power units, and fixed plant installations is considered.

A82 14710 New all electric system technology C W Clay (Boeing Commercial Airplane Co Seattle WA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 1 New York Institute of Electrical and Electronics Engineers Inc 1981 p 248 254

The status of electromechanical actuators (EMA) as a key element in the development of an all-electric aircraft system is investigated. It is found that the feasibility of EMA hardware has been amply demonstrated in laboratory systems and an EMA for a research aircraft. Attention is also given to a distributed data bus communication system, a distributed dc power system questions of overall system integration and the design of a flight deck. The reported evaluation study shows that hardware for a complete fly by wire all electric aircraft system is either available or will approach production readiness within a year or so. A program to integrate this hardware into a comprehensive single system is highly desirable to enhance development as well as optimize cost and weight benefits.

A82-14711 Weapon delivery system using GPS A K Aggarwal In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981
Volume 1 New York Institute of Electrical and Electronics Engineers Inc. 1981 p. 258 267

It is pointed out that in a highly dynamic vehicle such as a fighter aircraft the GPS User Set is augmented by an Inertial Measurement Unit (IMU) to maintain weapon delivery accuracy during high acceleration maneuvers. This GPS Weapon Delivery System furnishes highly accurate placement of air to ground weapons. The system uses a digital computer for computing the automatic release signal in conjunction with an Inertial Measurement Unit and a GPS User Set. The integrated Weapon Delivery System will work together with a Horizontal Situation Indicator a Vertical Gyro Indicator and/or a Vertical Display Indicator for displaying pilot aiming information.

A82 14712 Updated station deselection procedures to support automatic Omega receiver operation R D Healy R R Gupta (Analytic Sciences Corp Reading MA) and P B Morris (U S Coast Guard Washington DC) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 1 New York, Institute of Electrical and Electronics Engineers Inc 1981 p 268 273 10 refs

Many automatic Omega receivers use a station selection criterion which does not employ specific propagation related tests designed to avoid errors caused by wrong-way paths and westerly signal traverse of the magnetic equator. These errors can introduce navigationally significant errors into the Omega position solution, which can however be minimized by using the manual station deselection feature of the receiver. This paper describes these potential error sources and presents an updated Omega station selection chart containing specific recommendations for station deselection in a number of worldwide locations. A simple test for detecting wrongway path propagation is also included.

A82 14713 Navigation for helicopters by multiple use of inertial sensors V Held (Elektronik System Gesellschaft mbH Munich, West Germany) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 1 New York Institute of Electrical and Electronics Engineers Inc. 1981 p. 274 282

The paper presents a concept for the inertial functions flight control sight stabilization navigation of a helicopter. A minimum number of dislocated inertial sensors is proposed. The systems functions are accomplished on a system level by multiple use of the sensor signals. It will be proven that attitude and heading can be derived from the flight control and stabilization hardware so that the usually required attitude and heading reference for the navigation is saved. Moreover, the proposed concept provides as an additional function the autonomous initial alignment to north. (Author)

A82 14719

Distributed Time Division Multiple Access /DTDMA/ - A distributed signaling technique for advanced tactical communications J Rubin (ITT ITT Avionics Div Nutley NJ) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19-21 1981 Volume 1

New York Institute of Electrical and Electronics Engineers Inc 1981 p 332 337 7 refs Research supported by ITT

The Distributed TDMA concept based on the premise of maximizing the full utility of time frequency and code, is described This multidimensional approach contributes simultaneously to efficient multiple access antijamming and low probability of exploitation (LPE) system solutions. The multiple access problem is solved through pseudo random time and frequency hopping coupled with interleaved channelization which utilizes low duty signal structures. This random access technique is particularly suited to a Command Control. Communication/integrated communication navigation identification system as it provides intra-system and related function interference rejections.

A82 14720 # Future directions in CNI integrated avionics
R L Harris (USAF Avionics Laboratory Wright Patterson AFB
OH) In NAECON 1981 Proceedings of the National Aerospace and
Electronics Conference Dayton, OH May 19-21 1981 Volume 1
New York Institute of Electrical and Electronics

Engineers Inc 1981 p 338 344 21 refs

In order to appropriately satisfy the expected communications navigation and identification (CNI) requirements for tactical aircraft of the 1990's the estimates of volume, weight and cost of these functions must somehow be reduced. It is noted that the Air Force and Navy's technology programs for integrated CNI concepts have outlined baselines of current integratable hardware including the functions of HF UHF JTIDS GPS SEEK TALK and IFF interrogator/transponder the programs have also formulated architectures for future development. Among the developing technologies that affect integrated CNI are very large scale integration (VLSI), very high speed integrated circuits (VHSIC) the future programming language. Ada. and the development of charge coupled devices (CCD's) surface acoustic wave (SAW) devices magnetostatic wave (MSW) devices and microprocessing. The effects on integration are found to be significant.

A82 14721 # A modular multiplexed digital voice inter communications system R F Bolt and J J Seal (U S Navy Naval Avionics Center Indianapolis IN) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH, May 19 21 1981 Volume 1 New York, Institute of Electrical and Electronics Engineers Inc 1981, p 345 349 7 refs

The design and development of a modular multiplexed digital voice Intercommunications System (ICS) for military applications is described. This system, under development at the Naval Avionics Center, uses a dedicated MIL STD 1553B multiplexed data bus its modular design consists of Weapon Replaceable Assemblies (WRAs) The system architecture will provide integrated radio control using a single data bus that carries both digital voice data and control information. This ICS can be configured for a particular aircraft by arranging the various subsystem WRAs to satisfy the weapon system requirements. This paper discusses the functional requirements of the WRAs in the digital voice ICS System concepts have been demonstrated in the three station Multiplexed Digital Voice ICS This breadboard system provides ten bit rate/audio bandwidth combinations which have been evaluated for intelligibility in three aircraft acoustic noise environments. The intelligibility test results and the results of a package configuration study are summarized

(Author

A82 14723 Detection range analysis of an airborne medium PRF radar M B Ringel (Westinghouse Electric Corp., Baltimore MD) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton, OH May 19-21 1981 Volume 1

New York, Institute of Electrical and Electronics Engineers, Inc. 1981 p. 358-362 10 refs

The detection range of an air to air medium PRF radar is analyzed in terms of the signal processing involved in multiple PRF ranging, the nature of the ground clutter in the range Doppler space defined by such a radar and the radar/target kinematics. References containing prerequisite knowledge and similar analysis for other types of radars are cited and the analysis in this paper is compared to previous works. A flow chart of a computer program implementing the analysis outlined in this paper is presented. (Author)

A82 14725
Using phased array radar for data communications H D Lewis (RCA Government Systems Div Moorestown NJ) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 1

New York Institute of Electrical and Electronics Engineers Inc. 1981 p. 371 376

The idea of using a multifunction array radar at the controlling master station for the additional function of data transmission and reception is introduced. Here, cooperating stations equipped with suitable transponders are beacon tracked by the radar providing positive identification of each station as well as highly accurate positional data for the cooperating stations. Among the applications of this system are surface to air command and control long-range targeting and track from air to surface and surface to surface coordination, including both monostatic and multistatic operations. It is pointed out that the high power aperture product and low antenna sidelobes of the phased array radar are inherent characteristics that can be used in combatting ECM. What is more the ability of

multifunction phased array radar to revisit the cooperating station as often as required permits a reliable interchange of data on an interrogation/rely basis

C R

A82 14735 Computational considerations for fusion in target identification systems E. L. Waltz (Bendix Corp. Communications Div., Ann Arbor MI). In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference. Dayton. OH. May 19 21, 1981. Volume 2. New York. Institute of Electrical and Electronics Engineers. Inc. 1981. p. 492.497. 29 refs.

This paper presents an overview of the computational implications of applying multisensor data to the target identification problem Recent efforts to develop a mathematical basis for multisensor correlation (fusion) have been performed by the services and have been directed at local (autonomous) and regional (netted) systems for a wide range of applications. These studies have developed algorithms for ASW air air identification battlefield management ocean surveillance and air defense. An overview of these fusion algorithms' and their relationship to classical pattern recognition is presented. The hierarchical aspects of correlation combination and aggregation are described and their effects on system complexity are discussed. Key parameters, which characterize the general fusion system are described and related to processing requirements. These computational requirements are compared to expected VHSIC/VLSI capabilities to project the potential for integrated fusion processing in advanced avionics and weapons systems (Author)

A82 14739

Evaluating sources of error in EAR/GEANS navigation using a Kalman postprocessor S H Musick (USAF, Avionics Laboratory, Wright Patterson AFB OH) and N A Carlson (Intermetrics Inc Cambridge MA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH, May 19 21 1981 Volume 2

New York Institute of Electrical and Electronics Engineers Inc 1981 p 520 526 9 refs

EAR/GEANS is an integrated radar/inertial system consisting of a coherent multimode radar EAR and an accurate inertial naviga tion unit, GEANS. The EAR radar makes velocity and position measurements that aid GEANS while GEANS in turn supplies EAR with navigation data for measurement control and motion compensa tion. In this complex system many error sources affect navigation performance. This paper describes an effort to evaluate flight test navigation performance in terms of fundamental sensor error sources The various models and tools that were developed are discussed. The key tool is a high order Kalman filter called the Error Isolation Filter used as a postprocessor of flight recorded data Simulated flight test results are presented to demonstrate error recovery performance Performance of the EIF using actual flight data is discussed. The paper emphasizes the experiential aspects of the effort (Author)

A82-14740

The use of observers on relaxed static stability aircraft R H Rooney and E Y Shapiro (Lockheed California Co Burbank CA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton, OH May 19 21 1981 Volume 2 New York Institute of Electrical and Electronics Engineers Inc. 1981 p. 527 533

An observer is a dynamical system that reconstructs the states of a system that is used to drive it. Observers can be used when a normally available signal is unavailable due to sensor failure or as a sensor replacement when the use of a sensor may be undesirable due to operational considerations. The signal provided by the observer can then be used as an input to a controller for various purposes such as stabilization, optimization, or decoupling. The fundamentals of observer design are reviewed and simulation results of observers implemented on Relaxed Static Stability (RSS) aircraft are present ed. It is shown that while performance of observers in a RSS aircraft setting is degraded somewhat their use in unstable applications is not precluded. (Author)

A82 14741 Integrated Flight/Weapon Control design and evaluation W J Murphy (McDonnell Aircraft Co St Louis MO) and W L Young Jr (USAF Wright Aeronautical Laboratories Wright-Patterson AFB OH) In NAECON 1981 Proceedings of the

National Aerospace and Electronics Conference Dayton OH May 19 21, 1981 Volume 2 New York Institute of Electrical and Electronics Engineers Inc., 1981 p 536-543 Contract No F33615 79 C 3604

The Integrated Flight/Weapon Control (IFWC) program is aimed at developing integrated flight/fire control technology. This includes increasing weapon delivery capabilities, survivability and operability in the delivery of guided weapons and dispenser munitions. The completed development of selected concepts through preliminary design is presented pilot in the loop simulation was used for concept refinement and validation. The preliminary results based on pilot evaluation, showed that the tactical munitions dispenser weapon delivery system is accurate and provides increased survivability over conventional delivery. The air to surface missile delivery system was also found to be good especially in clear daylight conditions. The most favorably received feature of the IFWC air to air weapon delivery system was IFFC I/FIREFLY. III gunnery which had increased all aspect gun opportunities in precision pointing near head on long range opportunities and high angle off opportunities.

A82 14742 Software considerations in the design of computer generated flight displays M Miller (HRB Singer Inc State College PA) and A J Aretz (USAF Wright Aeronautical Laborato ries, Wright Patterson AFB OH) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 2 New York, Institute of Electrical and Electronics Engineers Inc 1981 p 544 548

The use of formats which take advantage of color imagery and the capabilities of a digital computer is one way of presenting information to pilots that is clearly understandable and requires little interpretation. The functional requirements of four specific graphic presentations and their impact on the design of the display generation software are discussed. The four formats considered are (1) the tactical situation format. (2) the stores status format. (3) the head up display format, and (4) the integrated flight path format. Due to the dynamic nature of the aircraft, the formats are also required to be dynamic, with a minimum update rate of 5. Hz. Attempts to simulate flight and generate the integrated flight path format have achieved an update rate of 2. Hz. Generating color pictures with computer graphics is essentially a paint by number exercise, where color assignment is determined from a VLT.

A82 14743 # The influence of smart computers on the cockpit of the future N L Gravely and J O Mysing (USAF Wright Aeronautical Laboratories, Wright Patterson AFB, OH) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton, OH May 19 21, 1981 Volume 2

New York Institute of Electrical and Electronics Engineers Inc 1981, p 549 556 7 refs

Recent developments in digital technology at the Air Force Wright Aeronautical Laboratories are presented which will have great impact on the cockpit of the future. Characteristics of the Digital Avionics Information System representative of the state of the art in cockpit technology are first discussed. Future capabilities to be achieved by artificial intelligence are then outlined flexible cockpit reconfiguration crew decisions aided by computerized systems consultant machines that understand and converse in free text and computer vision that can interpret sensor images. A very high speed integrated circuitry (VHSIC) is being developed which would extend and refine the metal oxide semiconductor and bipolar technology to increase through put rates and improve reliability while decreasing size and power consumption. Compared to the present F 16 computer the VHSIC would provide a 90% reduction in size volume and weight an 85% decrease in power and a 100% increase in MTBF. An intelligent software program (modification of MYCIN /Bernhard 1980/) is being considered which would aid the pilot during in flight system failures. Subsystem developments in the areas of graphics and computer generated imagery, dynamic pictorial displays image processing and aircraft emergency procedures are also discussed

A82 14744 A methodology for missile launch envelope display evaluation G E Corrick (Hughes Aircraft Co Culver City CA) and P V Kulwicki (USAF Aerospace Medical Research

Laboratory Wright Patterson AFB OH) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 2 New York Institute of Electrical and Electronics Engineers Inc 1981 p 557 564 Contract No F33615 79 C 0508

A methodology for objective evaluation of advanced display formats is described. A computer generated, manned, non interactive single target air combat simulation was used to evaluate two advanced VSD (vertical situation display) and HUD formats with respect to current F 15 air combat displays. The principal perfor mance measures obtained were pilot responses to questions about the simulated engagement and a measure of the cognitive workload imposed by the format assessed by the Sternberg reserve capacity task. The pilots comments and opinions were also obtained in a post evaluation debriefing. Nine operational Air Force pilots were subjects Results showed no large differences in performance on mission questions across formats but large differences in imposed cognitive workload All HUD formats imposed more workload than VSD formats and there was a strong correlation between the objective results and subjective opinions (Author)

A82 14745 # Assessing pilot workload Without disturbing pilot behavior R J Elder (USAF Warner Robins Air Logistics Center Robins AFB GA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19-21 1981 Volume 2 New York, Institute of Electrical and Electronics Engineers Inc. 1981 p. 565 571

The need for the design of practical pilot workload assessment techniques which do not obstruct the normal operational procedures of the pilot subjects is discussed. An analysis of the pilot tasks in an air-to air engagement is presented. Workload assessment techniques are analyzed for their applicability to the single seat fighter environment. The procedure for design of an experiment using these techniques is demonstrated for an F-15 air to air engagement. Applications of the method in weapon system modification and operational training evaluation are discussed. (Author)

A82 14750

Evaluation of advanced air to air gunnery fire control systems N M Shah and J Stalony Dobrzanski (Northrop Corp., Aircraft Div., Hawthorne, CA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 2

New York Institute of Electrical and Electronics Engineers Inc., 1981 p 615 622

Three advanced fire control systems based on the director type radar fire control system were designed for an advanced fighter aircraft. These systems are fixed gun trainable gun and integrated fire flight control (IFFC). In addition, an automatic range control (ARC) system which uses radar information for maintaining range with respect to target was designed. The air combat performance with each system was evaluated on the simulator with realistic radar noise and hardware constraints. The ARC was evaluated with fixed gun only. The results show definite superiority of the trainable gun even with relatively modest gun travel and servo power over a fixed gun and IFFC. The trainable gun. IFFC and ARC concepts provide improved tracking performance with considerable reduction in pilot workload over the fixed gun. The time to achieve first hit is shortest with the trainable gun. The ARC enhances survivability by minimizing overshoots with respect to the target.

A82 14759 # Assessment methodology of the lightning threat to advanced aircraft R A Perala (Electromagnetic Applications Inc Denver CO) and G A DuBro (USAF Wright Aeronautical Laboratories Wright Patterson AFB OH) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 2 New York Institute of Electrical and Electronics Engineers Inc 1981 p 691 697 19 refs

An overview of an assessment methodology concerning the lightning susceptibility of aircraft is presented Work in this area is concentrated on increasing the general understanding of the physics of the aircraft lightning interaction and on developing specific laboratory threat simulation testing techniques. Recent advances in both testing/simulation and analytics are discussed. These advances have been made possible by the incorporation of nuclear electro.

A82-14760

magnetic pulse technology and recent indications from measure ments of natural lightning which suggest that significantly greater electromagnetic energy exists in the frequency range where increased coupling of such energy to the aircraft is possible

B J

A82 14760

The Navy F/A 18A Hornet electromagnetic compatibility program J R Ketterer (McDonnell Aircraft Co St Louis MO) and J J Fisher (U S Naval Air Systems Command Washington DC) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 2

Electrical and Electronics Engineers Inc 1981 p 698 702

The F/A 18A Hornet is a first line carrier deployed aircraft employing advanced composite structures and state of the art digital electronics Because the electromagnetic environment (EME) generat ed on present day carrier decks can reach field strengths over 10 000 Volts/meter at some frequencies electromagnetic compatibility (EMC) challenges were presented. The approach to aircraft EMC design established for the F/A 18A required using the airframe as an enclosed electromagnetic (EM) shield. This shielding concept allowed equipment located within the airframe shield to be designed to a less severe EM environment than equipment located outside the airframe shield. Using the airframe as an electromagnetic shield presented a significant challenge particularly because graphite/epoxy composites represent more than one third of the F/A 18A surface area Overall this concept was found to represent the least cost weight and design impact both to the airframe and to the electrical or electronics equipments (Author)

A82 14761 A recursive time domain analysis of distributed line grid networks with application to the LTA/EMP problem W S McCormick (Wright State University Dayton OH) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 2 New York Institute of Electrical and Electronics Engineers, Inc., 1981, p. 703-708

Modeling the aircraft fuselage as a two node TEM lossy distributed network, a recursive time domain technique is presented to estimate the fuselage skin current induced by a remote lightning strike. The technique involves the determination of the two discrete nodal transfer functions followed by an application of Duhamel's theorem to the distributed electromagnetic excitation case. The Fourier transform of the induced fuselage skin current is presented as a function of the azimuth and elevation angles of the incident plane electromagnetic lightning excitation. Reference to the PORTER and NOAA flight programs is made along with a discussion of future application areas.

A82 14762 New advances in signal processing technology for integrated CNI avionics C R Ward and R A Reilly (ITT ITT Avionics Div Nutley NJ) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21, 1981 Volume 2 New York Institute of Electrical and Electronics Engineers Inc 1981 p 712 722 20 refs

Functionally integrated CNI (communication navigation and identification) radio systems appear to be attractive as a means of resolving size and weight conflicts between conventionally designed radio systems on space limited tactical military aircraft. In practice integration is often frustrated by basic incompatibilities between widely divergent signal structures. Although there are many very complicated aspects to the problem of functional integration, this paper addresses only the problem of accommodating the reception of different signal structures efficiently and flexibly in the RF to baseband domain. A radically different approach to radio receiver design is proposed which employs high speed digital and/or CCD technology which could be ready for field deployment by the 1990 time frame. Several alternative system level architectures are proposed and the tradeoffs between them evaluated. (Author)

A82 14763

Advanced integrated CNI architectures P C Camana S K Ogi and L R Stine (TRW Defense and Space Systems Group Redondo Beach CA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 1921 1981 Volume 2

New York Institute of Electronical and Electronics Engineers Inc. 1981 p 723 728

Integrated terminal architectures can produce a modern CNI

(communications navigation and identification) system at an affordable life cycle cost within real estate requirements. Major considerations include use of common modules. RF and digital large scale integration (LSI) technology insertion and high performance programmable digital signal processing. The RF subsystem consists of conventional RF and IF chains of common modules combined with the RF LSI technology. The digital processing subsystem is an array of programmable signal/data processors with the core element being a VLSI 100 MIPS single card signal processor. Common modules network reconfigurability and high level of integration will provide for lower life cycle costs with reduced systems size weight and power dissipation. (Author)

A82 14765

The agile transversal filter
Block for ICNIA D G Botha (USAF Wright Aeronautical Labora tories Wright Patterson AFB OH) and F W Smead (ITT ITT Avionics Div Nutley NJ) in NAECON 1981

Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21

1981 Volume 2

New York Institute of Electrical and Electronics Engineers, Inc. 1981, p. 735 740 USAF sponsored research

Integrated Communications Navigation and Identification Avionics (ICNIA) is an advanced development program to demon strate an integrated systems approach to the implementation of functions normally performed by a collection of independent black boxes. The system design partitions all CNI functions to optimize modular commonality within the ICNIA system. One function required in many parallel channels is the processing of signals with instantaneous bandwidths of 10 MHz or less. A specific implementation is the Narrow Band Agile Transversal Filter (NBATF) which can be implemented in state of the art technology can process signals with a variety of algorithms selectable under software control and can be replicated within the system, as required to perform the total set of functions. The NBATF constitutes a building block module within the ICNIA system.

(Author)

A82 14767 Applications of covariance analysis simulation to avionics flight testing A Foote C Vellenga J Price and W Buchholz (Logicon Inc Dayton OH) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 2 New York Institute of Electrical and Electronics Engineers Inc 1981 p 750-756

The application of covariance analysis simulation techniques to the conduct of developmental flight test of integrated navigation systems is presented. In particular, this paper describes how covariance analysis simulation techniques are being used in the planning execution and analysis phases of the B 52 Offensive Avionics System (OAS) flight test and discusses how they may be applied to future testing. The mission flexibility of modern strategic aircraft and the built in redundant modes of operation define a large number of scenarios which must be tested. The role of covariance analysis simulation techniques in the B 52 OAS flight test is to assist in the planning and execution phases and to provide information supplemental to actual flight test results. Discussions of the use of covariance analysis simulation techniques in each of these test phases are presented together with a sample of results from a B 52 OAS flight test.

(Author)

A82 14768

Application of multiple model estimation techniques to a recursive terrain height correlation system. W. Tang and G. L. Mealy (Analytic Sciences Corp. Reading MA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference. Dayton. OH. May. 19.21. 1981. Volume 2. New York, Institute of Electrical and Electronics.

Engineers Inc 1981 p 757 764 Grant No DAAK80 79 C 0268

This paper describes the results of a study which determined the performance capabilities of a recursive terrain correlation system proposed for low altitude helicopter navigation. A Monte Carlo simulation program was developed to assess the effectiveness of the terrain correlation algorithm. The sensitivity of the system to various error sources was evaluated and filter modifications to enhance system performance were proposed. An alternate configuration based upon multiple model estimation techniques was shown to afford a substantial decrease in system sensitivity to initial position uncertainty. (Author)

A82 14769 # Algorithms for an adaptive dynamic window in electronic map systems D L Sander (USAF Wright Aeronautical Laboratories Wright Patterson AFB OH) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton, OH May 19 21 1981 Volume 2 New York Institute of Electrical and Electronics Engineers Inc 1981 p 766 768

Algorithms have been developed for an adaptive dynamic window which closely conforms to irregular shaped areas. These algorithms advance the window as the aircraft moves adapt it to new geometries as they evolve and provide for buffer zones in advance of expected movement and maneuvers. This paper describes these algorithms following a brief discussion of past and present dynamic window techniques used by the Air Force Wright Aeronautical Laboratories Avionics Laboratory. (Author)

A82 14770

Airborne Electronic Map Systems I Design
R Hoffman and G Burnham (Texas Instruments Inc Dallas TX)
In NAECON 1981 Proceedings of the National Aerospace and
Electronics Conference Dayton OH May 19 21 1981 Volume 2

New York Institute of Electrical and Electronics
Engineers Inc 1981 p 769 772

The requirements and implementation of an Airborne Electronic Terrain Mapping System (AETMS) are discussed Display formats with plan views flat images and perspective views all comparable to window or boresight images or viewpoints other than the pilot's simulation of aircraft motion at speeds up to Mach one and cost effectiveness in eminimum cost and interface capabilities are mentioned as necessary aspects for simulation or in flight use. The data flow comprises a series of refinements of raw terrain data and time dependent user parameters and the limiting factor of storing only pertinent regional data for airborne use due to technological weight restrictions for stored memory is stressed. Processing and regional memory selection are examined including the use of up to 13 multipliers and 60 adders to perform up to 80 million operations/sec for a full range of CRT image generation.

A82 14771

Airborne Electronic Terrain Map System J W
Weber and E W Opittek (Hughes Aircraft Co El Segundo CA) In
NAECON 1981 Proceedings of the National Aerospace and Elec
ronics Conference Dayton OH May 19 21 1981 Volume 2
New York Institute of Electrical and Electronics
Engineers Inc. 1981 p. 773 778

The paper reports on the Airborne Electronic Terrain Map System Program which has resulted in the development of a flyable brassboard for the evaluation of display applications for the Defense Mapping Agency digital data base A summary of the display formats and supporting simulations such as the plan view contour and perspective views is given and a system description is presented which reviews features such as the regional memory display generator software and support equipment DLG

A82 14772 Passive terrain following using stored map and global positioning system A C Woodward and W M Hoover (Texas Instruments Inc Lewisville TX) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 2 New York Institute of Electrical and Electronics Engineers Inc 1981 p 779 785

The configuration and preliminary results are presented for a flight test program conducted to illustrate the potential for passive terrain following (TF) flight by combining current map storage the NAVSTAR Global Positioning System (GPS) and TF algorithm technologies Primary aspects of the GPS/MAP TF system and flight test program include terrain profile descriptions GPS position and aircraft state information and TF command computation. Results indicate that position/map techniques can be used in low level flight control and eventually operational systems should control primarily from position and map information.

A82 14773

Airborne Electronic Terrain Map System II

Applications G Burnham and C S Kline (Texas Instruments Inc

Dallas TX) In NAECON 1981 Proceedings of the National

Aerospace and Electronics Conference Dayton OH May 19-21

1981 Volume 2 New York Institute of

Electrical and Electronics Engineers Inc 1981 p 786 789

Applications of the Airborne Electronic Terrain Map System are considered. These include (1) the provision of covert, all weather weapon delivery for combat aircraft (2) the use of stored terrain data to substitute for data normally provided by a forward looking sensor. (3) the use of stored terrain data to generate a display that the pilot can use to fly low and avoid terrain higher than aircraft altitude, and (4) the extension of the system to sensor blending concepts with radar and FLIRs.

SCS

A82 14774

Technical/operational ATC scenarios for future TMA navigation K D Kricke and L Knapp (Elektronik System Gesellschaft mbH Munich West Germany) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19-21 1981 Volume 2

New York Institute of Electrical and Electronics Engineers Inc. 1981 p. 792 799 8 refs

Air traffic control is discussed in terms of the entire air traffic system and as a national authority. The terminal maneuvering area (TMA) is considered with reference to typical configurations approach and departure phases and such areas for improvement as possibilities for increased capacity environmental protection and fuel saving flight profiles. A number of possible advances in TMA scenarios are identified including three and four dimensional navigation secondary radar systems and data processing systems for automated air traffic control.

A82 14775 Some Italian research for developing new primary ATC radars M Calamia (Firenze Universita Florence Italy) In NAECON 1981, Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19 21, 1981 Volume 2 New York Institute of Electrical and Electronics Engineers, Inc. 1981, p. 800 807 15 refs

A survey of Italian research on primary air traffic control radar systems is presented. Types of clutter affecting such systems are discussed, and the parameters defining the filter capacity of radar with respect to clutter are identified as the improvement factor and subclutter visibility. Studies conducted to characterize dynamic clutter phenomena at airports in Rome and Naples in 1979 1980 are reported. Attention is given to adaptive moving target indicator filtering techniques. A method for the recording and analysis of atmospheric clutter ecnoes using an orthogonally polarized double channel receiver is considered.

A82 14776

Performance evaluation of target report ex tractor in the monopulse ATCRBS D Giuli M Fossi (Firenze, Universita Florence Italy) and E Dalle Mese (Pisa Universita Pisa Italy) In NAECON 1981, Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 2

New York Institute of Electrical and Electronics Engineers Inc 1981 p 808 815 11 refs Research sponsored by the Consiglio Nazionale delle Ricerche

In this paper some results are reported obtained via an analytical approach which are relevant to the performance evaluation of an Air Traffic Control Radar Beacon System (ATCRBS) monopulse extractor to be devised in a Discrete Address Beacon System (DABS) for Air Traffic Control (ATC) Suitable statistical models of the correlation tests used by the dwell time section of the receiver are developed. The obtained results refer to a statistical analysis of the dwell time section which performs the defruiting function.

A82 14777 A multimicroprocessor system for ATCRBS monopulse data processing E Borgheresi D Giuli F Pirri (Firenze Universita Florence Italy) G Oppimiti and C Poli (Marina Italiana Istituto G Vallauri Leghorn Italy) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 2 New York Institute of Electrical and Electronics Engineers Inc 1981 p 816-822 Consiglio Nazionale delle Richerche No 80 00385 91

In this paper the problem of the dwell time processing of aircraft replies in the Air Traffic Control Radar Beacon System (ATCRBS) section of the Discrete Address Beacon System (DABS) is considered A solution is suggested which is based on the use of a multimicroprocessor system. A brief description of the hardware structure of the system is given and the algorithms used for processing the replies are shown. Such algorithms aim at improving

A82-14778

the efficiency of correlation procedures among reply reports received by the same target during the antenna dwell time. Parallel processing is obtained through a sliced azimuth subdivision of the amount of the total job. (Author)

A82 14778 Flight management systems for modern jet aircraft R H Farmer (General Motors Corp Delco Electronics Div Goleta, CA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21, 1981 Volume 2 New York Institute of Electrical and Electronics Engineers Inc 1981 p 823 829 Contract No F09603 79 C 1610

Attention is given to flight management computer systems for modern jet aircraft noting tests run on Air Force C 141 aircraft Fuel saving aircraft operations are identified including optimum takeoff and climb schedules cruise Mach control optimized altitude selection delayed flaps ATC flow control and area navigation/direct routing Data from the C 141 Fuel Savings Advisory System are reported. In this system, the flight management system provides vertical navigation speed control flight planning control and horizontal flight path commands to the inertial navigation systems. The data show that significant fuel savings are possible by close attention to many small efficiencies of flight operations.

A82 14779

Weather impact on low altitude imaging in frared sensors in Europe

An availability model E R Edge (Analytic Sciences Corp Reading MA) J D Malick and J H Allen (SRI International Menlo Park CA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH, May 19 21 1981 Volume 2

New York Institute of Electrical and Electronics Engineers Inc 1981 p 832 839 5 refs

This paper discusses the development of a methodology for evaluating the availability of low altitude electro optical (EO) sensors for imaging of ground targets. Because of the wide range of possible target types and their possible geographical distribution a flexible tool for the assessment of current and future sensor designs is presented. This analysis tool which is available as a FORTRAN computer program named WEATHER includes a statistical model of all weather effects, accounts for seasonal diurnal and geographical variabilities allows for arbitrary distributions of targets and provides estimates of simultaneous outages over wide geographical areas

(Author)

A82 14780

Study of the effects of maneuver compensation on beam pointing accuracy D E Miracle (Logicon, Inc Dayton, OH) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 2

New York Institute of Electrical and Electronics Engineers Inc 1981 p 840 846 Contract No F33657 78 C 0490

It is commonly necessary to aim an airborne antenna consistent ly at a target antenna. This aiming is simple enough when angle measuring resources are devoted to the target but these resources are available only a small fraction of the time. Consequently with no compensation during maneuvers and between measurements the antenna may be aimed significantly off target. Consideration of this problem for present medium performance aircraft having state of the art navigational and EW systems indicates that several simplifying mathematical approximations are justifiable. These lead to a set of compensation algorithms which are operationally and computational ly superior to known alternative methods. The method involves performance angle measurements at a slower rate than is normally required relying upon a set of intermediate pointing corrections for coverage maintenance. The forms of the algorithms are simple enough to permit implementation on the EW computer or if necessary, other hardware (Author)

A82 14788

Conceptual design of an integrated power and avionics information system G L Dunn and P Leong (Boeing Military Airplane Co Seattle WA) in NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 3

New York Institute of Electrical and Electronics Engineers Inc 1981 p

954 962 5 refs Contract No F33615 80 C 2004

A nonintegrated DAIS type architecture has been used as a baseline to determine power system control requirements for a two engine tactical aircraft and to assess the relative merits of the hierarchical and integrated architectures. Two power generation and distribution configurations using solid state power controllers three power control system concepts and two integrated power and avionics architectures were considered. It is found that the integrated architectures with smart ELMCs (electrical load management centers) represents the best utilization of the data bus and has acceptable processor loading. The processor overhead is the least and both logical equation processing and bus loading make optimum use of the available DAIS technology capabilities for a single data bus.

A82 14789
60 kVA ADP permanent magnet VSCF starter generator system A program overview R C Webb (General Electric Co Binghamton NY) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 1921 1981 Volume 3 New York Institute of Electrical and Electronics Engineers Inc. 1981 p. 963 965 Contracts No F33615 78 C 2200 No F33615 74 C 2037

The paper reviews an Air Force sponsored program to design construct demonstrate flight worthiness and flight test 60 kVA variable speed constant frequency (VSCF) permanent magnet (PM) electrical starter/generator systems using high energy product samar ium cobalt magnets in an all metallic solid rotor PM VSCF system offers a significant improvement in electrical generating system efficiency over presently used systems. The PM VSCF also offers a simplification of the engine auxiliary gearbox area and aircraft ducting by combining the engine starting and electrical power generation functions into one system.

A82 14791 High speed PMG containment study for VSCF system M M Youn (General Electric Co Erie PA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 3

New York Institute of Electrical and Electronics Engineers Inc 1981 p 971 977 6 refs Contract No F33615 80 C 2032

A permanent magnet rotor containment method chosen for variable speed constant frequency (VSCF) applications is described. The containment method employs amortisseur bars in the magnetic member of the bimetallic shrink ring to reduce the commutating reactance of the generator for stable converter operation. The significantly higher energy product combined with high temperature capability of the magnet provides the basis for permanent magnet machines which are smaller higher in efficiency and more reliable than wound rotor machines.

A82 14792 Failure analysis of variable reluctance stepper motor D L Hart and J A Ziegenhagen (Dayton University Dayton OH) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 3 New York Institute of Electrical and Electronics Engineers Inc. 1981 p. 978 982

The variable reluctance stepper motor is an integral part of the electronic fuel control system on a jet engine in that it regulates the fuel flow to the engine. The stepper motor is required to operate in a high temperature environment while immersed in a jet fuel. This paper reviews the failure modes analysis techniques and the recommended corrective actions. (Author)

A82 14793

The payoff from U.S. Investment in aeronau tical research and development R. C. Lenz (Dayton University, Dayton OH) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 3

New York Institute of Electrical and Electronics Engineers Inc. 1981 p. 984 991 NSF Grant No. SRS 79 10397

This paper presents a quantitative analysis of the returns on U S investments in aeronautical research and development over the fifty years from 1926 to 1976. The returns on the investment are those obtained through productivity improvements in the airline industry independently of any other returns. The net gains from the R&D expenditures are very large in comparison with standard commercial

opportunities during the same period. However, neither the aircraft builders who performed most of the R&D nor the airlines who bought and used the aircraft received the largest part of the gain Instead, the gains were distributed primarily to the traveling public and to a lesser extent to airline employees. A key point of the research is the construction of probable aeronautical R&D expenditures for the years before 1957, the first year for which National Science Foundation statistics are available. Another feature is the use of seat mile data as the appropriate measure for airline output in the productivity calculations. An innovative concept, the use of hypo thetical phantom fleets' to determine productivity gains is introduced.

A82 14794 Parallel processing applied to digital flight control systems Some perspectives T F Westermeier (McDonnell Aircraft Co St Louis MO) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 3 New York Institute of Electrical and Electronics Engineers Inc. 1981 p. 1010-1017

Parallel processing techniques are thought to have the potential for increasing the performance of digital flight control systems. A number of issues are addressed to determine if the potential can be realized. The composition of generic flight control software is examined to determine its amenability to parallel solution. From this examination, two prototype software decompositions and their resulting architectures are proposed and evaluated in terms of iteration rate transport lag and computation time. The impact of parallel processing on size, weight power, and reliability is examined next. Finally, the throughputs of microprocessors are evaluated to determine their suitability as processing elements.

(Author)

A82 14796 Microprocessor flight control application study F C Neebe S J Hissong (General Electric Co Binghamton NY) and W E Nelson Jr (Northrop Corp Aircraft Div, Hawthorne CA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference, Dayton OH May 19 21 1981 Volume 3 New York Institute of Electrical and Electronics Engineers Inc 1981 p 1022 1029

Digital flight control computers are now being used to imple ment control functions on high performance military aircraft Microprocessor technology has advanced to the boint where it is possible to implement many simple control functions. Several microprocessor subsystems working in parallel can be used to set up systems which have extensive control capability. This paper describes the results obtained from setting up a small microprocessor system to perform pitch control for a modern lightweight fighter aircraft Information is presented detailing system configuration and response. (Author)

A82 14814 Implementing the DAIS executive S W
Behnen (Boeing Military Airplane Co Seattle, WA) In NAECON
1981 Proceedings of the National Aerospace and Electronics
Conference Dayton OH May 19 21 1981 Volume 3

New York Institute of Electrical and Electronics Engineers Inc., 1981, p. 1149-1154-8 refs

The Boeing Military Airplane Company has been studying the feasibility of applying the DAIS executive to a production aircraft system. The advantages and disadvantages of implementing a member of the DAIS executive family have been investigated for several existing and projected aircraft systems new and upgraded avionics systems flight control systems and an electrical power distribution and control system. Although certain operational requirements for these systems will entail enhancements in the current executive design, the basic philosophy and structure of the DAIS executive make it desirable in each of these systems. As a result of its favorable review of the DAIS executive BMAC is proposing to use DAIS executive variants on new systems such as an electrical power and distribution system and an avionics system. The decision to implement a DAIS executive in an upgraded version of an existing system will depend on the result of cost/benefit trades. (Author)

A82 14817

A storage device for subsystem maintenance information C J Tayora and H M Collins (Houston University Houston TX) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19-21

1981 Volume 3 New York Institute of Electrical and Electronics Engineers Inc 1981 p 1170-1174 Contract No F33615 80 C 1095

This paper describes the Electronic Nameplate (ENP) an electronic storage device which may be attached physically to avionic subsystems to store information relevant to their identification interface specifications calibration procedures fault isolation tests and operational performance. The ENP can be integrated into a single chip device with a standard connector through which it receives power and communicates. Prototypes of the ENP have been implemented and tested for the Air Force Wright Aeronautical Laboratories. (Author)

A82 14819

Computer modeling of an aircraft HVDC electrical system J D Segrest (U S Naval Material Command, Naval Air Development Center Warminster PA) and D L Sommer (Boeing Military Airplane Co Seattle WA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 3

New York Institute of Electrical and Electronics Engineers Inc 1981 p 1192 1199 11 refs Contract No N62269 79 V 0265

This paper describes the development of mathematical models which represent typical 270 VDC aircraft electrical systems and the analysis of these models on the EASY Model Generation and Analysis Program. The mathematical models of the following components of a high voltage dc (HVDC) electrical system were developed. (1) buck multiple loop switching regulator with EMI input filter. (2) dc solid rotor generation system. (3) dc wound rotor generation system. (4) flat conductor distribution bus and. (5) aircraft load. The EASY program is then used to analyze a system by specifying the topology of a network of these predefined components. Sample simulation results are included. (Author)

A82 14820 Digital simulation of aircraft electrical generating system by means of Sceptre program D Fair J Dhyanchand, E Parker and H Bahanassy (Sundstrand Advanced Technology Corp., Rockford IL) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21 1981 Volume 3 New York Institute of Electrical and Electronics Engineers Inc 1981 p 1200 1205 5

A computer program is presented which simulates the aircraft electrical generating system. In this computation analysis, a constant speed drive with electronic governor brushless aircraft ac generator and voltage regulator are simulated as a system. These subsystems were linked for a complete aircraft electrical power generating system by means of the Super Sceptre program and FORTRAN subroutines. The 60 KVA Sundstrand Aircraft Generating System was simulated with this model for on off transient loads. The simulated results were found to be in close agreement with experimental data.

A82 14821 Computer simulation of an advanced aircraft electrical system A J Marek D F Sellers (Vought Corp Dallas TX) and D Fox (USAF Wright Aeronautical Laboratories Wright Patterson AFB OH) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 1921 1981 Volume 3 New York Institute of Electrical and Electronics Engineers Inc. 1981 p. 1206 1215

Computer simulation programs which were developed for advanced aircraft electrical system designs are described. The programs consist of four separate modules encompassing the IDG generating system. VSCF generating system parallel generator operation and the power distribution system. Each program is written in FORTRAN V and is based on data supplied by power generating system mainfacturers and data derived from various texts. This paper describes the procedure for program development program features structures parameters and accuracy and program solution run times. The capabilities of the developed programs are discussed and a representative sample of simulation runs with computer plots are presented.

A82 14823 # Airborne color CRT displays H L Warus zewski Jr (USAF Aeronautical Systems Div Wright Patterson AFB, OH) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21

1981 Valume 3 New York Institute of Electrical and Electronics Engineers Inc 1981 p 1224 1243 15

It is suggested that new human factors data and cockpit requirements need to be developed and applied to color cockpit displays so that requirements for a usable display can be generated The color display technology needs to be evaluated with regard to satisfying the established human factors requirements. Test method ologies need to be developed to determine the compliance of the color displays with the specification requirements. In addition, color displays need to be integrated into the cockpit using total cockpit human factors criteria to maximize the possible workload reduction and safety of the aircraft. Such color display technologies as beam penetration color CRT and shadow mask color CRT are described and applications of color CRTs (including tactical and map displays and flight control and engine displays) are considered

The Maneuvering Flight Path Display A flight trajectory solution display concept J F Watler Jr and W B Logan (Northrop Corp. Aircraft Div. Hawthorne CA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton, OH, May 19 21 1981 Volume 3 York, Institute of Electrical and Electronics Engineers Inc. 1981 p. 1254 1260 5 refs

The Maneuvering Flight Path Display (MFPD) provides to the pilot an anticipatory, real time presentation of the command flight path. The presentation depicts the 'solution' of the desired trajec tory, thus telling the pilot 'what to do and 'how to do it. This information is displayed graphically eliminating the need for the traditional dials, scales pointers, or alpha numeric readouts. The pilot by controlling the aircraft to fly just above the graphical flight path being portrayed, is assured of precise 4 D trajectory control It is concluded that the success of the MFPD development and the consequent rapid maturation of the concept has stimulated a widespread interest in advancing the program to flight demonstration as quickly as possible

A82 14825 # The LANTIRN wide field of-view raster Head-Up Display R L Berry and J C Byrd (USAF Aeronautical Systems Div Wright Patterson AFB OH) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH, May 19 21 1981 Volume 3 New York Institute of Electrical and Electronics Engineers, Inc. 1981 p. 1261 1268

As part of the Low Altitude Navigation and Targeting Infrared for Night (LANTIRN) System, a new Head up Display (HUD) is being developed as replacement for the existing HUDs in the F 16 and A 10 aircraft. The primary improvements will be greatly increased field of view and the capability to display Forward Looking Infrared (FLIR) video. The HUD will use diffraction optics in the combiner as the main tool by which improvements in field of view contrast ratio and see through visibility are achieved This paper is an overview of the use of diffraction optics in the **LANTIRN HUD** (Author)

A82 14826 Enhanced aircraft handling qualities by longi tudinal dynamics mode decoupling H Y Kim R H Rooney, and E Y Shapiro (Lockheed California Co Burbank, CA) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton, OH May 19 21 1981 Volume 3

New York, Institute of Electrical and Electronics Engineers Inc 1981 p 1270 1275

The present paper investigates decoupling procedures using output feedback on longitudinal axis dynamics of a wide body transport aircraft. The possibility of decoupling through output feedback is rather restrictive compared to the possibility of full state feedback Therefore when output feedback decoupling is not possible the state variables are reconstructed by the Luenberger observer to be used in full state feedback decoupling of the system The results of this approach are presented via simulation (Author)

A synthesis technique for highly uncertain and interacting multivariable flight control systems I Horowitz O Yanıv B Golubev and L Neumann (Weizmann Institute of Science Rehovot Israel) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19-21

1981 Volume 3 New York Institute of Electrical and Electronics Engineers Inc 1981 p 1276 1283 7 refs Grant No AF AFOSR 80 0213

A recent synthesis technique has the attractive property that the uncertain multiple input output (MIO) feedback problem is convert ed into a number of uncertain single loop problems. Under certain general conditions the solutions of the single loop problems are guaranteed to be satisfactory for the MIO problem. This technique is applied to the Ay direct side force mode of a fighter CCV aircraft The objective is to achieve fast Ay response with small sideslip and roll over a range of flight conditions. Three designs of varying complexity are presented with simulation results. The technique clearly reveals the conflicting design factors and trade offs (Author)

Direct digital design method for reconfigurable multivariable control laws for the A7D Digitac II aircraft, D W Potts (USAF Flight Dynamics Laboratory Wright Patterson AFB OH) and J D Azzo (USAF Institute of Technology Wright Patterson AFB OH) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference Dayton OH May 19 21, 1981 Volume 3 New York Institute of Electrical and Electronics Engineers Inc 1981 p 1284 1291 8

This paper investigates control of an aircraft when there is a primary control surface failure. The object of this study is to reconfigure the remaining control surfaces to compensate for the additional forces and moments generated by the inoperative control surface. To study this flight control problem, a comprehensive aircraft model is required which considers each control surface operating individually. A six degree of freedom aircraft model is developed including all the individual control surfaces. The additional coupling between the axes requires the derivation of several new non-dimensional control derivatives. With the new comprehen sive aircraft model the entire eigenstructure assignment method is used to assign both the eigenvalues and the eigenvectors to the closed loop plant matrix. This method is used for the direct digital design of a multivariable discrete regulator control law (Author)

Design of direct digital flight-mode control systems for high performance aircraft B Porter and A Bradshaw (Salford University Salford Lancs England) In NAECON 1981 Proceedings of the National Aerospace and Electronics Conference, Dayton OH May 19 21 1981 Volume 3 York Institute of Electrical and Electronics Engineers Inc. 1981 p 1292 1298 5 refs Contract No F49620-81 C 0026

The general results of Bradshaw and Porter (1981 1981) on discrete time tracking systems are used to design fast sampling error actuated digital controllers and associated transducers which effect fuselage pitch pointing and vertical translation maneuvers in the case of the F 16 aircraft. It is thus demonstrated that these severe maneuvers can be readily effected by appropriate fast sampling error actuated digital controllers which generate practically accept able flaperon and elevator deflections. Furthermore it is also demonstrated that such fast sampling digital controllers are extreme-(Author)

A82 14831 General purpose real time interaction panel for digital simulation M T Lansdaal and M E McSharry (Boeing Military Airplane Co Advanced Airplane Branch Seattle WA) In NAECON 1981 Proceedings of the National Aerospace and Elec tronics Conference Dayton OH May 1921 1981 Volume 3 New York Institute of Electrical and Electronics

Engineers Inc 1981, p 1305-1310

Real time simulations for modelling aircraft or flight control systems often need a controlled real time event insertion and event monitoring capability. This capability is necessary to study the responses of the simulated system to controlled events or distur bances A description is presented of an approach providing the solution of event/fault insertion and event monitoring requirements The approach makes use of an intelligent device known as the Fault Insertion Panel (FIP) which consists of a minicomputer with a Multiprocessor Communications Adapter a Direct Memory Access I/O board a video terminal and a hand held control box. The FIP is an inexpensive and versatile replacement for special purpose hard ware such as an aircraft cab/flight deck and analog instrumentation that must interact with a digital simulation

A82 14856

AN/TPN 25 and AN/GPN 22 precision approach radars H R Ward (Raytheon Co Wayland MA) In International Radar Conference Arlington VA April 28 30 1980 Record

New York Institute of Electrical and Electronics Engineers Inc 1980 p 26 31

A Precision Approach Radar (PAR) is used in a Ground Controlled Approach (GCA) aircraft landing system to make accurate aircraft position measurements during the final approach to the runway. The PAR recently developed for the U.S. Air Force uses a limited scan phased array to scan acquire and track landing aircraft. This paper describes the transportable and fixed site models of this PAR as well as the results of field tests to verify their coverage and measurement accuracy. (Author)

A82 14857 Radar hostile fire location D J Colliver (Royal Signals and Radar Establishment Malvern Worcs England) and J D Holcroft (Racal MESL Linlithgow Scotland) In International Radar Conference Arlington VA April 28 30 1980 Record New York Institute of Electrical and Electronics Engineers Inc. 1980 p 32 37

Methods for detecting an attack involving the firing of projectiles are considered taking into account also the determination of the direction to the source of fire. It is found that for the considered objective radar based approaches have important advantages compared to other methods. The requirement for the radar to track projectiles down to short ranges favors the use of a CW system and Doppler processing. Suitable radar hardware is discussed along with aspects of signal processing taking into account a hybrid processor and a digital processor. Radar systems of the considered type are used in fixed and mobile installations in a security role and have also been installed covertly in armored VIP limousines. Other applications are related to a battlefield environment.

A82 14868 Commercial airborne weather radar technol ogy G A Lucchi (RCA Avionics Systems Div Burlington MA) In International Radar Conference, Arlington VA April 28 30 1980 Record New York Institute of Electrical and Electronics Engineers Inc. 1980 p. 123 130

From World War II until very recently there has been little change in the technology of commercial airporne weather radar. The technique being used is still based on the concept of differentiation between various radar backscatter intensities which can be related to rainfall rate. The radar backscatter coefficient for various rainfall rates has been determined sufficiently well for weather radar design calculations Experiments continue at this time because there are widespread backscatter coefficients depending on such variables as temperature raindrop size raindrop shape and turbulence in the storm cell. Two aircraft were equipped for the conduction of airborne experiments in an attempt to better correlate radar signals with measured turbulence in storm cells. At least three radar manufacturers are developing airborne weather radar systems com plying with a new characteristic for a weather radar Recently a low-cost weather radar system which can be mounted in the leading edge of a single engine aircraft wing was introduced

A82 14871 Inverse SAR and its application to aircraft classification G Dike R Wallenberg (Syracuse Research Corp Syracuse NY) and J Potenza (USAF Rome Air Development Center Griffiss AFB, NY) In International Radar Conference Arlington, VA April 28 30 1980 Record New York Institute of Electrical and Electronics Engineers Inc 1980 p 161 167

Two-dimensional radar images of aircraft have been simulated with parameters similar to those of the ARPA/Lincoln C Band Observables Radar (ALCOR) which has been used in actual radar imaging studies. Development of such a simulation program was necessitated by a need to provide a controlled flight situation to study aircraft image projection planes and a desire to use the simulation to aid in developing sorting algorithms for use in aircraft classification. The classification approach taken avoids the problem of extraneous responses due to multiple rays engine modulation internal antenna scanning and the addition of stores to the unknown aircraft. A degree of insensitivity to poor focusing is also expected.

A82 14881 Air to-ground MTI radar using a displaced phase center phased array M L Stone and W J Ince (MIT Lexington MA) In International Radar Conference, Arlington VA April 28 30, 1980, Record New York Institute of Electrical and Electronics Engineers Inc 1980 p 225-230 5 refs USAF sponsored research

An airborne MTI radar capable of performing surveillance of tactical targets has been assembled and field tested. The design features an electronically scanned displaced phase center antenna an advanced digital signal processor and real time automated target acquisition and display. The radar represented a scaled model of an all weather long range system. Results obtained in the rejection of clutter the detection of moving targets and the acquisition and tracking of targets are discussed.

A82 14908

A new approach to radar plot extraction for ATC applications

N Accarino and E Giaccari (Selenia S p A Rome Italy) In International Radar Conference Arlington VA April 28 30 1980 Record

New York Institute of Electrical and Electronics Engineers Inc. 1980 p. 391 396

It is noted that the capabilities of modern ATC radars require more effective target coordinate evaluation and target resolution capabilities in the extractor than have been available in the past. The availability of powerful processing tools such as microprocessors makes possible the implementation of sophisticated algorithms to provide optimum radar plot extraction. A new extraction algorithm implemented by means of a simulation approach is described. The improvement in performance is extensively compared with the values obtained using a conventional extractor. The approach described here is given in terms of the following improved characteristics range and azimuth accuracy range and azimuth resolution and target qualification.

A82 14909 Extended time radar raw video recording R Inagaki and M Mochii (Nippon Electric Co Ltd Tokyo Japan) in International Radar Conference Arlington VA April 28 30 1980 Record New York Institute of Electrical and Electronics Engineers Inc 1980 p 397 402

An attempt is made to develop extended time recording of the radar video for analyzing air traffic control accidents. The combination of a commercial time lapse video cassette tape recorder and sophisticated video time compression techniques with radar band width compression demonstrates its validity in realizing 32 hour recording of the ARSR video without deteriorating its image quality from a practical point of view. Improvement in some circuit instability will make it possible to put this newly developed equipment into actual operation in association with magnetic tape recording of the processed digital radar data.

A82 14927 * The X 14 24 years of V/STOL flight testing R M Gerdes (NASA Ames Research Center Moffett Field CA) (Society of Experimental Test Pilots Symposium 25th Beverly Hills CA Sept 23 26 1981) Society of Experimental Test Pilots Technical Review vol 16 no 2 1981 p 3 21 7 refs

The X 14 V/STOL research aircraft made its first free hover flight as a proof of concept test bed on Feb. 19. 1957. With the exception of two subsequent modification periods (to X 14A and X 14B) this V/STOL workhorse has been on continuous flight test status as a research aircraft and flying classroom. The paper presents some of the highlights of its memorable 24 year flight test career with special emphasis on projects which have contributed to V/STOL technology and on the test pilots who made it happen. (Author)

A82 14928 Ball Bartoe Jetwing flight tests R D Kimber lin (Tennessee University Tullahoma TN) (Society of Experimental Test Pilots Symposium 25th Beverly Hills CA Sept 23 26 1981) Society of Experimental Test Pilots Technical Review vol 16 no 2 1981 p 22 40

Design features and flight test results of the Jetwing aircraft are reported. The Jetwing employs an upper surface blowing concept in that all engine air is ducted through the leading edge of the wing and ejected over the top surface of the wing through a slot nozzle to achieve supercirculation lift and STOL performance. The nozzle extends over 70% of the wingspan. A Coanda flap is mounted at the

75

trailing edge of the blown portion of the wing and a smaller wing is located over the slot nozzle in low speed flight to reduce installed thrust losses. A test plane with a 21.75 ft wingspan powered by a single 2200 lb thrust engine has completed 137 test flights. Test instrumentation is described and in flight performance with sawtooth climbs at over 55 knots airspeed yielded a lift coefficient of 3.5 and a blowing coefficient of 1.0. Takeoff and landing ground roll were less than 1000 ft. keeping within design goals of a STOL aircraft suitable for aircraft carrier and short, unimproved runway use.

A82 14929 Flight investigations of integrated descent rate control systems W D Thompson (Society of Experimental Test Pilots Symposium 25th Beverly Hills CA Sept 23 26 1981) Society of Experimental Test Pilots Technical Review vol 16 no 2 1981 p 41 53

Results of tests to determine the effectiveness of spoilers for enhancing aircraft landing control are reported. Combining the spoiler with a throttle control formed a descent rate control which improved handling performance produced effective drag control and lift and moment coupling and expanded the approach airspeed window. The landing ground distances increased from 600 to 1000 ft as the approach angles increased. The spoiler control is viewed as a glide path control which establishes a linear relationship between rate of sink and throttle position. Inexperienced pilots were able to achieve touch down accuracies comparable to those displayed by experienced pilots flying normal aircraft. No hard landings were encountered during landing testing the higher approach speeds simplified landings in gusting conditions, and braking during landing roll was reduced.

A82 14930 Progress report CH-47 modernization program J C O Connor (U S Army Aviation Research and Development Command St Louis MO) (Society of Experimental Test Pilots Symposium 25th Beverly Hills CA Sept 23 26 1981) Society of Experimental Test Pilots Technical Review vol 16 no 2 1981, p 54 64

Progress toward improving the CH 47D sufficiently to fill the Army medium lift requirements through the year 2000 is reviewed. The mandatory mission profile includes pick up of a 15 000 lb load at 4000 ft at 95 F ambient temperature climb 200 fpm for one minute cruise outbound for 30 nm and return with fuel reserves for 30 nm. The CH 47D employs twin turbine engines tandem counter rotating blades and can transport troops cargo and weapons in day night visual and instrument conditions. An adaptation of the Chinook the CH 47D has a 30 min oil out capability has passed through preliminary air evaluation tests and features an advanced flight control system which allows hands off flight Reliability availability and maintenance tests revealed no uncorrectable problems after 342 flight hours although blade coating may be necessitated by a sparkling phenomenon that occurs during night flights in sandy conditions.

A82-14931 USNTPS spin program J R Watkins (U S Navy Naval Air Test Center Patuxent River, MD) (Society of Experimental Test Pilots Symposium 25th Beverly Hills CA Sept 23 26 1981) Society of Experimental Test Pilots Technical Review vol 16 no 2 1981 p 82 86

The Navy Test Pilot School spin program is described including test procedures for out of control flight and the aircraft employed. The T 2C Buckeye and X 26A Frigate are the current training aircraft Students observe upright incipient oscillatory and nonoscillating spin and recovery and are then required to perform similar maneuvers before practicing upright spins as command pilots inverted spins are terminated at 1.5 g and parameters such as minimum entry altitude mandatory action altitudes and pre and post flight aircraft inspection are outlined A 30 min out of control flight program is discussed noting the presence of a chase plane to gather telemetry on rotation roll yaw, and pitch/angle rates, and on altitude loss (1000 ft/turn)

A82 14932 The USAF Test Pilot School high angle of attack and spin training program M D Edmondson (USAF Test Pilot School Edwards AFB CA) (Society of Experimental Test Pilots Symposium 25th Beverly Hills CA Sept 23 26 1981) Society of Experimental Test Pilots Technical Review vol 16, no 2 1981 p 87 91

The training program at the Air Force Test Pilot School is reviewed. The course is conducted in academic flight training and reporting phases and high angle of attack and spin conditions are accentuated. Students are exposed to in depth studies of aerodynam ic inertial gyroscopic and other forces and moments necessary for fully developed spin. Flight training begins in sailplanes equipped with a tape recorder and a kneeboard and proceeds to an A 37B with a 42 channel pulse code modulated data acquisition system. Spin missions are safety monitored by an instructor on TV provided by a radar tracking telescope. Spin recoveries in the sailplane and T 37B are described including erect and inverted spins. An A 7D vehicle is employed for high angle of attack training, noting the hazard of pilot disorientation during high energy departures and rapid angular attitude changes.

A82 14933 Navy spin evaluation of the A 7 airplane configured with automatic maneuvering flaps C L White and L E Parrish (U S Navy Naval Air Test Center, Patuxent River MD) (Society of Experimental Test Pilots Symposium 25th Beverly Hills CA Sept 23 26 1981) Society of Experimental Test Pilots Technical Review vol 16 no 2 1981 p 92 107

Test results of Navy evaluation of automatic maneuvering flaps (AMF) on an A 7B aircraft are presented. The spin characteristics, the effects of asymmetric drop tank loading on the spin characteristics and the effects of nose up longitudinal trim on the A 7 departure recovery were examined. The AMF are on both leading and trailing edges of the wings modifications to the A 7 necessitated by the use of AMF are listed along with instrumentation and flight test procedures. AMF was found to enhance the departure spin and recovery handling characteristics. The asymmetric fuel tank loading was destabilizing at high angles of attack but was negated by the presence of AMF. Recommended departure procedures were determined as optimal recovery techniques and details of the flight test maneuvers for spin entry recovery and in asymmetric loading conditions are presented.

A82 14934 F/A 18A high angle of attack/spin testing I M Behel and W G McNamara (U S Navy Naval Air Test Center Patuxent River MD) (Society of Experimental Test Pilots Symposium 25th Beverly Hills CA Sept 23 26 1981) Society of Experimental Test Pilots Technical Review vol 16 no 2 1981 p 108 132

High angle of attack (AOA) and spin test flights for the F/A 18A aircraft are discussed noting that high spin resistance features of the control laws necessitated a second separate set of control laws for spin recovery. Wind tunnel and model testing results are reviewed with the 16% model yielding more accurate performance prediction than the 6% scale model. The control laws scheduled the maneuvering flaps to increase departure and spin resistance with full flap extension an optimum configuration for AOA above 25 deg. Instrument feedback for longitudinal stability is outlined and the logic mode for spin recovery is discussed. Finally the pilot cues high AOA characteristics and spin and spin recovery characteristics defined during flight testing are examined and the benefits of spin recovery cockpit displays for rapid recovery in stressful situations are emphasized.

A82 14935 KC 10 flight test program W S Smith (Douglas Aircraft Co Long Beach CA) and B Hinds (USAF Edwards AFB CA) (Society of Experimental Test Pilots Symposium 25th Beverly Hills CA Sept 23 26 1981) Society of Experimental Test Pilots Technical Review vol 16 no 2 1981 p 136 142

Test features and results of refueling interface with various aircraft with the KC 10 Advanced Tanker/Cargo Aircraft are report ed. The program sought to define the performance characteristics and operational capabilities of a converted wide body commercial plane the DC 10 freighter as a military cargo and refueling plane. Modifications for the refueling receptacle slipway bladder fuel tanks boom and hose-drogue refueling system are outlined along with instrumentation alterations. The KC 10 can carry 356 065 lb of fuel or 85 tons of cargo. Acceptable clearances for ground operations were demonstrated and damping of boom oscillations at high Mach numbers was achieved during tests refueling the C.5. Further tests with the B.52 A.10. F.16. F.4. F.15. A.7D and A.7K aircraft as receptors were successfully completed. Twelve KC 10 aircraft will be

operated to extend the Air Force's worldwide deployment operations

D.H.K.

A82 14936 The all composite Lear Fan 2100 H G
Beaird Jr (Lear Fan Corp Reno, NV) (Society of Experimental
Test Pilots Symposium 25th Beverly Hills CA Sept 23 26 1981)
Society of Experimental Test Pilots Technical Review vol 16 no
2 1981 p 144 153

Design and performance features of the all composite Lear Fan 2100 aircraft are described. The plane has two engines one tail mounted propeller and can climb at 1400 fpm with one engine out. The structure is a graphite composite which results in a greater range than with aluminum due to lighter weight plus a longer lifetime due to higher durability. The engines provide 850 shaft high papiece and the metallic content in the oil is electronically monitored to remain within a wide safety margin. Standard aiferons elevators and rudders are controlled through cables and pushrods. The operational altitude is 41,000 ft at 435 mph with the cabin pressurized to 8000 ft use of one propeller eliminates the occurrence of asymmetric thrust conditions. Overall, simplicity, reliability durability, and safety were the guiding principles in the design of the aircraft. Nominal operation is given as a Mach 0,65 speed and 31,000 ft altitude.

A82 14937 Acceptance testing of the Calspan variable stability Learjet, W J Brooks J W Smolka (USAF Test Pilot School Edwards AFB CA) R M Norman (US Navy Test Pilot School Patuxent River MD) and A E Schelhorn (Calspan Advanced Technology Center Buffalo NY) (Society of Experimental Test Pilots Symposium 25th Beverly Hills CA Sept 23 26 1981) Society of Experimental Test Pilots Technical Review vol 16 no 2 1981 p 154 181

The variable stability system incorporated into a Learjet for use as a flying classroom for USAF and USN Test Pilot students is described. Side by side cockpit seating an observer station a data station and the capability of flight in a three axis fly by wire mode are provided. Various linear and nonlinear flight control system characteristics along with simulating prefilter effects and transport delay are incorporated in the controls a number of closed loop flight control system configurations are also included. Components of the variable stab "y system are discussed noting the ability of the digitally controlled response feedback system to simulate control reactions of various aircraft in response to the student pilot s control actions when handling numerous aircraft dynamic configurations

DHK

A82-14938 F 15 SAR G L Jennings and P Henry (McDonnell Aircraft Co St Louis MO) (Society of Experimental Test Pilots Symposium 25th Beverly Hills CA Sept 23 26 1981) Society of Experimental Test Pilots Technical Review vol 16 no 2 1981 p 182 197

The evolution and capabilities of the F 15 synthetic aperture radar (SAR) as an aid to all weather interdiction capabilities are discussed. The radar has eight components and a 384K memory with Doppler beam sharpened (DBS) and air to ground capability. DBS involves cutting the radar beam into azimuth elements and a processing detection filter in each element range/azimuth resolution is 250 ft. Design goals of 8.5 ft resolution involve the application of coherent processing which is the SAR. The antenna senses a point on the ground for a preditermined period of time to produce the required synthetic aperture. The 8.5 ft resolution SAR is currently operational for bombing target identification.

A82 14939 F/A 18 roll rate improvement program M J Tkach (McDonnell Aircraft Co St Louis MO) (Society of Experimental Test Pilots Symposium 25th Beverly Hills CA Sept 23 26 1981) Society of Experimental Test Pilots Technical Review vol 16 no 2 1981 p 198-202

The roll rate improvements made during the F/A 18 Full Scale Development Program are reviewed. Detection of low wing stiffness and high aerodynamic damping led to thickening the web and caps of the aft main spar and adding additional layers of composites to the skin aft of the main torque box. Roll power was increased by extending the aileron span implementing differential edge flaps and increasing the differential tail authority. Steady state roll at altitudes above 10 000 ft resulted. Differential leading edge flaps were then added to prevent roll rate decay at lower altitudes. A position stick

will replace the current force stick to allow the F/A 18 to exceed the time-to bank requirements throughout the flight envelope DHK

A82 14940 AV-8B technical update Leading edge root extension development C A Plummer (McDonnell Douglas Corp., St Louis MO) (Society of Experimental Test Pilots Symposium 25th Beverly Hills CA Sept 23 26 1981) Society of Experimental Test Pilots Technical Review vol 16, no 2 1981 p 203 209

The effects of leading edge root extensions (LERX) on the instantaneous turn rate of the AV 8B aircraft are investigated. The LERX was 5 5 ft long with an 11 ft span and an anhedral of 11 deg the planform comprised 7 5 sq. ft/side, for a net gain of 15 sq. ft. a net weight of 150 lb. and a shift of the center of gravity by 0.5%. A total of forty four test flights carrying various weaponry configurations were conducted for data on the full flight envelope. V/STOL cruise speed fuel efficiency maximum speed and dynamic stability and control were either unchanged or beneficially affected. Buffet was reduced and instantaneous turn rate increased 21% although some decrease in longitudinal stability was noted. A reduction of the all composite LERX to 4.2 ft/side lowered the turn rate increase 17% and kept the decrease in longitudinal stability to 2.5% which was acceptable.

A82 14946 † Safety of helicopters in flight (Bezopasnost poletov vertoletov) A M Volodko Moscow Izdatel stvo Transport 1981 224 p 21 refs in Russian

Safety related aspects of single rotor and coaxial helicopter operation are summarized with reference to aerodynamics flight dynamics, aeroelasticity vibrations and dynamic strength of struc tures performance of gas turbine engines and automatic control systems reliability crew performance and aeronautical meteorol ogy. The physical meaning of the principal flight restrictions contained in the flight manual is examined and possible errors are discussed. Finally, special situations involving complicated flight conditions and equipment failure are discussed along with recommendations on flight safety and accident investigation.

A82 14952

U.S. Navy life support development trends D.

N. DeSimone (U.S. Naval Material Command Naval Air Development Center Warminster PA) In Survival and Flight Equipment
Association Annual Symposium 18th San Diego CA October
12 16 1980 Proceedings Canoga Park CA
Survival and Flight Equipment Association 1981 p. 1.4

The methodology and trends in navy aircrew life support research and development are reviewed. Life support and survival gear are complementary between all services where flight safety escape or survival functions may overlap. The hardware and procedural use development of any component undergoes explora tory development advanced development and advance engineering development before deployment. Research and development activities are initiated to respond to high accident rates crew member functional constraints. POW reports and updated logistics systems. Programs currently exploring improvements in environmental and escape systems fixed seating parachutes with no maintenance protective clothing survival and rescue and physiological standards for equipment are described.

A82 14953 * Emergency in flight egress for general aviation aircraft L J Bement (NASA Langley Research Center Hampton VA) In Survival and Flight Equipment Association Annual Symposium 18th San Diego CA October 12 16 1980 Proceedings Canoga Park CA Survival and Flight Equipment Association 1981 p 16 24

A NASA program for development of an inflight egress system for the left (pilot) door of general aviation aircraft is described. The pyrotechnic release door was felt to be necessary because of pilot difficulty in reaching the right door when subjected to spin/stall centrifugal effects. A flexible linear shaped charged of hexanitrostibene. If and a lanyard actuated detonator are discussed along with mock up tests and instrumentation. The egress system was designed for minimum structural impact minimum pilot initiation procedures. Iow weight and no egress interference and to provide sufficient force to blow off the door have low required maintenance and high reliability. Results of 68 tests are reviewed noting the inclusion of a screen to keep glass fragments from spraying the cabin.

Certification was achieved and uses in the F 111 and B 1 aircraft are noted MS K

A82 14954 * Operational evaluation of thunderstorm penetration test flights during project Storm Hazards 80 G L Keyser Jr P L Deal B D Fisher and N L Crabill (NASA Langley Research Center Hampton VA) In Survival and Flight Equipment Association Annual Symposium 18th San Diego CA October 12 16 1980 Proceedings Canoga Park CA Survival and Flight Equipment Association 1981 p 44 49

The National Aeronautics and Space Administration is conduct ing a research project called Storm Hazards 80 in order to study the prediction detectability and avoidance of the hazards of severe storms for aircraft operations. The project using a highly instrument ed NASA F 106B airplane to penetrate thunderstorms gathered and correlated data from both airborne and ground based instrumenta tion. The objectives of this project are to determine the effects of lightning on the design and operation of aircraft composite structures and digital electronic systems. The data will be used to determine the correlation of lightning hazards with other severe storm hazards such as heavy precipitation hall turbulence and wind-shear in order to develop an initial data base for use in design and avoidance. The NASA F 106B was equipped with a weather radar stormscope lightning measurement instrumentation and air sampling equipment This paper will focus on the operational aspects of thunderstorm penetrations and the pilot techniques used to avoid the extremely hazardous portions of the storm such as the tornadoes and hail. It will deal with the effects of the storm elements on the aircraft hardware avionics and the crew

A82 14955 Testing of the SJU 5A ejection seat for the F/A 18 /HORNET/ aircraft. T A Pavlik (U S Naval Air Systems Command Washington DC) and B Macnab (Martin Baker Aircraft Co Ltd Uxbridge Middx England) In Survival and Flight Equipment Association Annual Symposium 18th San Diego CA October 12 16 1980 Proceedings Canoga Park CA Survival and Flight Equipment Association 1981 p 62 65

Results of developmental testing of the F/A 18 ejection seat are discussed. Changes which were required to the basic configuration MK 10 seat included standard U.S. materials and processes environ mental sealing of the mechanical devices redundancy of critical components single point safety handling incorporation of a navy seat kit oxygen and restraint system and incorporation of parachute water pockets. Difficulties encountered due to the intercontinental distribution of production and testing sites are outlined and the parachute pyrotechnic device and survival kit are considered noting that testing comprised 14 ejections at speed from 0.600 knots. The seat is now standard equipment on the F/A 18

MSK

A82 14956

Rescue at sea R G Eberhardt (U.S. Naval Weapons Center Parachute Systems Dept China Lake CA) In Survival and Flight Equipment Association Annual Symposium 18th San Diego CA October 12 16 1980 Proceedings

Canoga Park CA Survival and Flight Equipment Association 1981 p $66\ 67$

The Sea Water Activated Release System (SEAWARS) Program has the objective of reducing the number of aircrew member drownings that occur after a successful ejection and parachute descent into the ocean. This paper addresses the historical evolution and development of the SEAWARS Program a brief overview of the system requirements preliminary Navy evaluation and current program status. (Author)

A82 14958

'Little people problem /MA 2 torso harness/
V M Voge (U S Navy Naval Safety Center Norfolk VA) and H
Pheeny (U S Naval Weapons Center China Lake CA) In Survival
and Flight Equipment Association Annual Symposium 18th San
Diego CA October 12 i6 1980 Proceedings
Canoga Park CA Survival and Flight Equipment Association 1981
p 76 79

Changes necessary to the MA 2 torso harness to accommodate use by smaller people notably females are described Measurements of flying personnel weighing less than 140 lb and shorter than 66 in resulted in a decision to keep the between K fitting distance at a minimum of 75 in which serves as a disqualification level. An

adjustable cinch strap has been added to the leg straps to compensate for people who are big enough yet experience difficulties with proper fitting. Best fit requirements are presented noting that people who cannot be fit with a standard harness are candidates for custom fit harnesses. Research into a nylon system with greater negative and lateral g restraint features is indicated. M.S.K.

A82 14960

Automatic parachute releasers for premeditated parachuting E Puskas (Para Flite, Inc. Pennsauken NJ) In Survival and Flight Equipment Association, Annual Symposium, 18th San Diego CA October 12 16 1980 Proceedings

Canoga Park CA Survival and Flight Equipment Association 1981, p 84 86

This paper is presented to inform members of the organization of the state of the art of Automatic Parachute Opener design, specifically the design of those used for premeditated parachuting. This presentation covers the history the philosophy used in establishing design parameters, the technical differences in design dictated by specific applications the description and the differences in technology of the two primary design approaches currently in use current trends in utilization and direction that development of these devices will take in the foreseeable future (Author)

A82 14961
The history of the development of the GQ aeroconical parachute 1971 1980 A J Harrison (GQ Defence Equipment Ltd Woking Surrey England) In Survival and Flight Equipment Association Annual Symposium 18th San Diego CA October 12 16 1980 Proceedings Canoga Park CA Survival and Flight Equipment Association 1981 p 93 96

Development and testing of the GQ aeroconical parachute, which is used to all variants of the MK 10 ejection seat, are reviewed. The chute has a 36 in diameter vent equalling 18% of the flying diameter. Two 11 7 sq ft panels positioned to the rear of the canopy at a 45 deg angle from the axis of symmetry allow a positive forward gliding component. Details of the structural materials are presented and 55 medium/high speed trial drop tests are described. A 20.3 ft/sec rate of descent is provided by the chute a rate which is not necessarily affected by torn seams. Results of ejection seat tests are provided noting functional success at Mach 0.98 at 14.000 ft with a maximum deceleration of 26.6 g. The chute inflates within 1.22 sec deployment occurs at 64 ft/sec and water pockets are included in the design to collapse the chute within 5 sec of a water landing.

MSK

ARE 14963

A new safety harness for mobile aircrew D C Reader (USAF School of Aerospace Medicine Brooks AFB TX) In Survival and Flight Equipment Association Annual Symposium, 18th San Diego CA October 12 16 1980 Proceedings

Canoga Park CA Survival and Flight Equipment Association 1981 p 106 109

A safety harness for mobile crewmembers in both fixed and rotary winged aircraft has been designed. It consists of a self tightening assembly of straps attached to a life preserver which is attached to an aircraft strong point by a strap with length adjustment. The safety harness has been assessed for comfort compatibility with other items of aircrew equipment strength in suspension and drop tests and is now recommended for service trial (Author)

A82 14965 Further test results of parachutes with automatic inflation modulation /A I M / D B Webb (Irvin Industries Canada Ltd Fort Erie Ontario Canada) In Survival and Flight Equipment Association Annual Symposium 18th San Diego CA October 12 16 1980 Proceedings Canoga Park CA Survival and Flight Equipment Association 1981 p 116 123

An automatic inflation modulation canopy for the next genera tion of ejector seats is described. The parachute features the use of unidirectional Kevlar stretch fabric in the crown area of the canopy and an auxiliary parachute inside the main canopy mouth. The intent is to reduce the overall recovery flight path distance with a lower peak opening force. A network of reefing lines are organized it experts from tangling by a central marquisette which is held at a fixed point in the center of the canopy by a positioning line connected to the center point of the canopy. Whirl tower overinflation and descent control, and deployment tests results are reported, and a 29.6 ft diam parachute was shown to display overinflation control.

steady state stability and consistency of inflation timing at speeds up to 275 knots at 16 000 ft MS K

A82 14966 A look at the Hoffman Triangular parachute
The first successful glidable parachute D Gold (U S Naval Weapons
Center Parachute Systems Dept China Lake CA) In Survival and
Flight Equipment Association Annual Symposium 18th San Diego
CA October 12 16 1980 Proceedings
Canoga
Park CA Survival and Flight Equipment Association, 1981 p
124 131

The development of the Hoffman Triangular parachute is described. Several designs were considered and a cloverleaf configuration with a 25 ft canopy was chosen. A short skirt opposite a lineless tail allowed for an increase in the glide velocity of the canopy. The pilot parachute also featured four vanes, a springless elastic container flap system to throw the chute away from the jumper and rubber bands to retain bighted suspension lines in the container. The company that produced the parachute failed in business but the use of the rubber bands to retain the suspension lines became a standard feature of parachute containers.

A82 14972 Evaluation of a selected group of anti exposure garment configurations for their effects on the operational performance and survival of Naval aircrewmen S M Reeps D C Johanson and L J SantaMaria (U S Naval Material Command Naval Air Development Center Warminster PA) In Survival and Flight Equipment Association Annual Symposium 18th San Diego CA, October 12 16 1980 Proceedings Canoga Park CA Survival and Flight Equipment Association 1981 p 183-191

A82 14974 Test and evaluation of improved aircrew re straint systems G T Singley III (U S Army Applied Technology Laboratory Fort Eustis VA) In Survival and Flight Equipment Association Annual Symposium, 18th San Diego CA October 12 16, 1980 Proceedings Canoga Park CA Survival and Flight Equipment Association 1981 p 196 201 7 refs

US Army aviation accident data shows that a majority of all injuries in attack helicopters could have been avoided if these aircraft had been equipped with crashworthy seat and restraint systems. The compactness of the cockpit and the close proximity of mission equipment to the aircrew in attack and scout helicopters pose serious crash impact hazards. Although not desirable from a crashworthiness standpoint operational considerations may dictate that mission equipment and structure be located within the occupant's crash impact motion envelope. Given this situation, it is critical to the occupant's crash impact survival chances that he be provided with a restraint system that minimizes his crash impact motion envelope particularly for his head. The cockpit can be delethalized further when the improved restraint is complemented by padding potential strike surfaces in the cockpit making contact surfaces frangible and providing weapon system sights with frangibility telescoping and/or swingaway features. This paper presents the results of an effort to test and compare the potential of several aircrew restraint systems to reduce the crash impact motion envelope of helicopter aircrewmen (Author)

A82 14975

Design of a crashworthy crew seat for the Boeing Vertol Chinook helicopter R F Campbell (Boeing Vertol Co Philadelphia PA) In Survival and Flight Equipment Association Annual Symposium 18th San Diego CA October 12 16 1980 Proceedings Canoga Park CA Survival and Flight Equipment Association 1981 p 202 208

The design and test results of a crashworthy seat for the Chinook are presented. Requirements for the seat included the ability to withstand a crash pulse of 30 g peak with a 50 fps velocity change, and a vertical pulse of 48 g peak with a 42 fps velocity change based on a 0 065 sec pulse duration. An armored bucket capable of protecting against a 30 cal projectile at 100 m was fabricated, and three adjustable attenuator wires were added each sized to stroke at 600 lb over the seven in minimum stroking distance. Features of the support structure the armored Kevlar bucket cushions restraints and testing procedures are outlined and current work on a self-adjusting infinitely variable attenuator is indicated as a means to provide a constant inertia system.

A82 14976 Crashworthy military passenger seat development. L Domzalski (U.S. Naval Material Command Naval Air Development Center Warminster PA) In Survival and Flight Equipment Association Annual Symposium 18th San Diego CA October 12 16 1980 Proceedings Canoga Park CA Survival and Flight Equipment Association 1981 p 209 215 11 refs

The performance criteria design concepts and test results for Navy crashworthy fixed wing aircraft passenger seats are reviewed Noting the enhanced crashworthiness of a rearward facing seat crash pulses with 30 deg pitch 19 deg roll and 30 deg yaw are mentioned as dynamic test criteria. Ultimate static loading factors are defined and the lack of velocity change data from accident investigation reports is stressed as a deficiency. A two passenger seating airrange ment with a total weight of 55 lb was chosen and included a double harness/lap belt configuration. A steel bench able to withstand a velocity change of 64 fps while supporting two 250 lb passengers resulted with a maximum energy absorber force setting of 3000 lb on the leg struts. Tests of the seat showed a resistance to up to 8 g force (4000 lb) about half the requirements and indicate a need to redesign to comply with rearward and lateral static load/deflection criteria.

A82 14977 HASEP Survival from crashed Navy helicopters J Micciche (U.S. Naval Material Command Naval Air Development Center Warminster PA) and J J latesta (Sanders and Thomas Inc. Pottstown PA) In Sirvival and Flight Equipment Association Annual Symposium 18th San Diego CA October 12 16 1980 Proceedings Canoga Park, CA Survival and Flight Equipment Association 1981 p. 216 220 6 refs

The Navy s Helicopter Aircrew Survivability Program (HASEP) was originally planned to enhance the inflight recovery and survival capability for helicopter aircrewmen HASEP more recently has been directed to eliminate inflight recovery. It focuses on the survival technologies with high near term payoff. The currently active technologies are discussed taking into account the H 46 helicopter emergency flotation system the helicopter emergency egress lighting system a comparison of underwater helicopter escape lights the H 46 crashworthy cargo restraint a crashworthy troop seat integration for H 46 and an automatic life raft system.

A82 14978

Analysis of escape systems at 687 KEAS D T
Ther and R F Yurczyk (Boeing Military Airplane Co Seattle WA)
In Survival and Flight Equipment Association Annual Symposium
18th San Diego CA October 12 16 1980 Proceedings

Canoga Park CA Survival and Flight Equipment Association 1981 p 221 225 Contract No F33615 79-C 3406

Attention is given to the Advance Ejection Seat program which was concerned with the selection of deployable aerodynamic devices to reduce the acceleration levels of an ejection seat. The object of this program was to find a configuration which could operate at a dynamic pressure of 1600 psf and satisfy the acceleration requirement of MIL S 94798. Estimated aerodynamic coefficients were used in a three degree of freedom simulation to select a set of configurations which seemed sufficiently promising to be analyzed in a wind tunnel. Refined aerodynamic coefficients were obtained from wind tunnel tests and these data were used in the simulation to select the final configuration. The simulations show that improvement of seat acceleration performance is a complex problem which is not solvable by simply reducing drag. It was found that control of seat attitude and stability is essential to good acceleration performance.

A82 14979 Wind tunnel tests of ejection seat for high dynamic pressure escape J O Bull and R F Yurczyk (Boeing Military Airplane Co Seattle WA) In Survival and Flight Equipment Association Annual Symposium 18th San Diego CA October 12 16 1980 Proceedings Canoga Park CA Survival and Flight Equipment Association 1981 p 226 230 USAF supported research

In connection with the employment of the currently used multimode rapidly sequenced ejection system it was found that a higher injury and fatality rate resulted from more ejections at high speed. A program was initiated to evaluate advanced ejection seat concepts for escape in the high dynamic pressure regime (1600 PSF or 687 KEAS). A description is presented of the wind tunnel test.

A82-14980

phase of the program Wind tunnel data were obtained on 12 high Q ejection seat configuration variations. Complete six component data were obtained throughout an angle of attack angle of yaw and Mach number range to obtain a basis for conducting six degree of freedom computer simulations of ejection seat stability trajectory and performance characteristics. Based on a preliminary review of the data a seat with 18 deg boom and stabilizer and a seat with 18 deg boom and stabilizer plus a flow diverter appear to be the most viable candidates for the high Q ejection seat.

A82 14980

Performance assessment of the ACES II ejection seat-A 10 configuration E O Roberts (USAF Flight Dynamics Laboratory Wright Patterson AFB OH) In Survival and Flight Equipment Association Annual Symposium 18th San Diego CA October 12 16 1980 Proceedings

Canoga Park CA Survival and Flight Equipment Association 1981 p 231 234

A brief overview is presented of a performance analysis of the ACES II ejection seat for the A 10 aircraft. The analysis is conducted with the aid of a computer simulation program called SAFEST which stands for Simulation and Analysis of In Flight Escape System Techniques. A comparison between track test results and the computer simulation has shown very good simulation. This correlation indicates that complete simulation has now been realized. The obtained results can be used to design and develop new and improved escape systems at lower costs. The analysis proves the value of computer simulation in the design and the evaluation of ejection seat systems.

A82 14981

Post ejection survival B Limbrey (Martin Baker Aircraft Co Ltd Uxbridge Middx England) In Survival and Flight Equipment Association Annual Symposium 18th, San Diego CA October 12 16 1980 Proceedings

Canoga Park CA Survival and Flight Equipment Association 1981 p 235 238

The causes of fatalities occurring during escapes involving ejection seats are examined. It is found that 62% of fatalities were due to striking the ground before the parachute had time to develop. The second principal cause of fatality is drowning or lost at sea presumed drowned (25%). The remaining causes of fatality are many and varied and each makes up only a very small proportion of all fatalities. Approaches are discussed for aiding the aviator who descends on his parachute into the sea. Attention is given to fatalities occurring in the cases of a single point parachute release and a multiple parachute release. It was found that the number of fatalities for single point releases was much smaller than for multiple releases.

A82 14982

Terrain actuated deployment system J K
Seitler (ARO Corp Buffalo NY) In Survival and Flight Equipment
Association Annual Symposium 18th San Diego CA October
12 16 1980 Proceedings Canoga Park CA
Survival and Flight Equipment Association 1981 p 239 244

A description is presented of a radar altimeter which was developed to automatically detect when an ejectee after man seat separation and a five second delay reaches a height of 500 through 100 feet above the terrain. The radar altimeter then triggers the deployment of the survival kit and subsequent inflation of the life raft contained in the survival kit. The radar altimeter uses a solid state transmitter and a tuned RF receiver at the transmitter frequency. Sufficient sensitivity and selectivity is assured by RF amplification and filtering. The video processing and timing circuits process received terrain echos only if they exceed the threshold level and are associated with heights of from 100 to 500 feet.

A82-14983 A system safety program for aircraft production and deployment. L E Rackley (General Dynamics Corp Fort Worth TX) In Survival and Flight Equipment Association Annual Symposium 18th San Diego CA October 12 16 1980 Proceed ings Canoga Park CA Survival and Flight Equipment Association 1981 p 245 249

Changes are sometimes made to an aircraft without adequate consideration of system safety or other specialty engineering aspects. An investigation is conducted concerning the implementation of suitable approaches for avoiding such a neglect with respect to vital system characteristics. It is found to be important that system safety is also considered during design changes made after fleet deployment.

System safety considerations should have a significant effect on the decision making process of implementing the change. In order to follow the given recommendations however it will be necessary to establish an adequate system safety data base during the development phase and maintain it through the production phase and as long after fleet deployment as necessary.

A82 14984

A ballistic design model for initiators for aircraft personnel escape systems. B E Paul (SCOT Inc. Downers Grove IL) In Survival and Flight Equipment Association Annual Symposium 18th San Diego CA October 12 16 1980 Proceedings

Canoga Park CA Survival and Flight Equipment Association 1981 p 250 252

In a review of the T 38 interseat sequencing system it was found that more information was needed regarding the pressure history in an initiator system. In response to this observation a ballistic model was developed which characterizes the entire pressure space time function in the initiator. The model was applied to two diverse initiators. The correlation was found to be quite good. The model was also applied to conditions which yielded rather high in tube peak pressures, and predicted a similar occurrence. It was then used to establish a method for improvement of this condition. It appears that the model can be efficiently utilized for the development of any new initiator system or the modification of current systems. The model is capable of handling layouts with multiple branches and/or multiple initiator sources.

A82 14985 Analytical and experimental characterization of the JAU 14/A cartridge actuated initiator for use in aircrew escape system performance evaluation A M Varney R J Brandstadt J D Martino (Applied Combustion Technology Inc. Orlando FL) and J L Hinds (U S Navy Naval Ordnance Station Indian Head, MD) In Survival and Flight Equipment Association Annual Symposium, 18th San Diego CA October 12 16, 1980 Proceedings

Canoga Park CA, Survival and Flight Equipment Association 1981 p 253 255

A82 14998 † The technology of sheet metal stamping in the production of aircraft /2nd revised and enlarged edition/ (Tekhnologiia zagotovitel no shtampovochnykh rabot v proizvodstve samoletov /2nd revised and enlarged edition/) M N Gorbunov Moscow Izdatel stvo Mashinostroenie 1981 224 p 43 refs. In Russian

The general characteristics of sheet metal stamping operations are discussed followed by a detailed description of the individual stamping procedures. This includes the location and spacing of blanks and means of improving the quality of the cutting edge. The bending method is then described including a discussion of the stress strain state the minimal radius of bending bending with tangential tension and compression and bending with radial compression. The flanging and expansion processes are discussed as is stretch wrap forming molding and die forging. Attention is also given to the stamping of more complicated shapes and to other methods of stamping in the production of aircraft.

A82-15311 Prediction and performance of radome-covered reflector antennas P J B Clarricoats C G Parini and M S A S Rizk (Queen Mary College London, England) (International Union of Radio Science Symposium on Electromagnetic Waves 10th Technische Universitat Munchen Munich West Germany Aug 26 29, 1980) Radio Science vol 16, Nov Dec 1981 p 1105 1110 Research supported by the Science Research Council

The return loss (reflection coefficient) of a paraboloidal radome is predicted by a physical optics method based on the power coupling theorem. An asymptotic form of the reflection coefficient is found to be very accurate and consistent with a simple geometric optics interpretation. A method to reduce the return loss is investigated using a hemispherical iris loaded sandwich section of the center of the radome and an improvement of approximately 5 dB is observed over a useful frequency bandwidth. Contributions of the radome to the radiation pattern of the antenna are identified and those near to boresight are predicted.

A82 15468 # A criterion for determining the causes of wind shear at Punta Raisi Airport, on the basis of statistical data from barograph records (Ricerca di un criterio per la determinazione delle

cause del wind shear verificatosi nell aeroporto di Punta Raisi attraverso i dati statistici rilevati da registrazioni barografiche) O Cosentino (Aeronautica Oblitare Servizio Meteorologico Rome Italy) and G Ferlazzo (Palermo Universita Palermo Italy) Rivista di Meteorologia Aeronautica vol 41 Apr June 1981 p 127 135 7 refs. In Italian

A statistical analysis has been conducted on pressure jumps appearing in the barograph records of Punta Raisi airport which are compared with such corresponding meteorological parameters as wind temperature and humidity in order to determine the synoptic local and orographic causes of the phenomena. Attention is given the characteristics and causes of wind shear in the geographical context of the airport and it is concluded that prefrontal or frontal pressure variations accompanied by local elevation phenomena with cumulus clouding result in horizontal wind shear over the area in which barometric jumps are experienced.

A82 15482 † Study of the load carrying capacity of aviation gas turbine engine impellers under low cycle loading at normal and high temperatures (Issledovanie nesushchei sposobnosti rabochikh koles kompressorov aviatsionnykh GTD pri malotsiklovom nagru zhenii v usloviiakh normal noi i povyshennykh temperatur) V G Bazhenov A D Baliuk B G Reznik and V P Gontarovskii (Kievskii Politekhnicheskii Institut Zhitomir Ukrainian SSR) Problemy Prochnosti Nov 1981 p 45 48 In Russian

A rotor was designed for testing the impeller of gas turbine engines under low cycle loading considering the force interaction of neighboring stages. The stress strain state of a disk of an impeller was calculated by means of an algorithm based on the finite element method and the theory of small elastoplastic deformations. The load carrying capacity of the impeller is estimated under conditions approximating those found in a real operational environment.

A82 15596 Direct free flight analysis of aircraft dynamics at high angles of attack M E Beyers (South African Council for Scientific and Industrial Research National Institute for Aeronautics and Systems Technology Pretoria Republic of South Africa) Aeronautical Society of South Africa and South African Institute of Aeronautical Engineers Journal vol 2 no 1 1981 p 17 28 26 refs

Concepts are examined for the analysis of high maneuverability aircraft dynamics on the basis of gross flight dynamic effects observed in wind tunnel free flight experiments. Experimental and analytical techniques developed to study the generic nonoscillatory free flight motion of flight vehicles trimmed at significant angles of attack are reviewed. The feasibility of aircraft model free flight tests is demonstrated on the basis of simulations and trajectory validation schemes are proposed for the corroboration of free flight and captive model dynamic data. Finally, the rationale underlying the utilization of data gathered in captive and free model dynamic stability tests of high performance aircraft is examined in the context of design objectives of high maneuverability and good flying qualities. (Author)

A82 15597 A matter of seconds A critical account of three notable air disasters /5th Major Miller Memorial Lecture/ C S Margo Aeronautical Society of South Africa and South African Institute of Aeronautical Engineers Journal vol 2 no 1 1981 p 30 35

Three aircraft accidents are analyzed for causes and remedies A DC 10 crash of May 25 1979 comprised the loss of an engine on take off and subsequent loss of control leading to grounding 31 sec later. Continued unsymmetric repair maintenance and replacement of the engines from one side or the other had led to structural failure and loss of control occurred in the absence of stall indication and power from the side of the lost engine. An increase of speed is judged to have been capable of preventing the crash. Although little evidence was left after the accident that killed Dag Hammarskjold, an evaluation is given that the pilotis knowledge of the height above sea level was uncertain. Finally, a crash of a Boeing 707 on April 20 1968 is determined to have happened because of premature transition from take off to climb power. It is noted that the pilot had had a total of one hour s experience with that particular version of the 707.

A82 15599 Computer image generation for flight simula tion B J Schachter (Westinghouse Defense and Electronics Systems Center Baltimore MD) *IEEE Computer Graphics and Applications* vol 1 Oct 1981 p 29 32 34 38 40-46 (17 ff) 130 refs

The features and capabilities of computer image generation for producing effective imagery for flight simulation are explored CRT operational parameters designed to meet necessary realism for human visual interaction are outlined noting the eye's tendency to concentrate on one small area of resolution at a time. Four currently available systems are examined along with control logic the NASA three view space flight simulator and block diagrams of information routing. VLSI processors holographic image displays interactive computer graphics and optical disks are considered for advanced simulator systems.

A82 15606 Experimental investigation of total pressure loss and airflow distribution for gas turbine combustors Z M Fan and Z F Chao (China Gas Turbine Research Institute People's Republic of China) [Journal of Engineering Thermophysics vol 1 May 1980 p 185 194) Engineering Thermophysics in China vol 1 Apr June 1980 p 207 217 Translation

Results of theoretical and experimental investigations are presented to demonstrate the feasibility of a solution for certain one dimensional simultaneous equations. The current flow drag method and the hole blanketing experimental method are shown to have difficulties and a simple technique of calculation using the mean flow coefficient is provided. Results of calculations in accordance with the one dimensional flow simultaneous solution are compared with those obtained with the mean flow coefficient method and experimental results showing good agreement. D.L.G.

A82 15625

Large terminal maneuvering areas Operational problems
Possible development of solutions (Les grandes zones de manoeuvre terminale Problèmes operationnels Evolution possible des solutions)
J. L. Garnier (Direction de la Navigation Aerienne, Paris, France) (Organisation Europeenne pour I Equipement Electronique de la Navigation Aérienne Forum Technique, Rome Italy May 15, 1981) Navigation (Paris) vol. 29, Oct. 1981 p. 443 451 In French

The operational problems associated with large terminal maneu vering areas (TMAs) are examined and means by which these problems may be alleviated by the use of expected technological advances are considered. The TMA is defined as the region of space occupied by flights departing from or having a destination in the area concerned within which aircraft are climbing towards or descending from their cruise levels. Means currently in use for the management of air traffic within a TMA such as that of Paris are indicated Current problems arising in the use of TMAs are attributed to the phenomena of high traffic levels and the necessity of standbys in the presence of the competing priorities of large capacity and user economics. The possible contributions of the DABS selective addressing secondary radar system, MLS and precision DME to the resolution of these problems are examined, and it is concluded that while all these techniques have their place in the TMAs of the future, additional measures in the areas of onboard navigation equipment, automated ground assistance and traffic control systems are required ALW

A82 15655 † Current aerial cameras (Sovremennye aerofotoapparaty) V G Afremov and V B II in Geodeziia i Kartografiia
Oct 1981 p 40-42 6 refs In Russian

The paper considers the development and operation of the TE and TES aerial cameras having focal distances of 350 100 70 and 50 mm and FOV angles of 40 103 120, and 136 5 deg respectively for 18 x 18 cm frames. The basic technical characteristics and some applications of these cameras are presented.

A82 15721 † Quality optimization and unification of avia tion gasolines (Optimizatsiia kachestva i unifikatsiia aviatsionnykh benzinov) V E Emel ianov K A Demidenko and B A Englin (Vsesoiuznyi Nauchno Issledovatel skii Institut Neftianoi Promysh lennosti, Moscow USSR) Khimiia i Tekhnologiia Topliv i Masel no 11 1981 p 18 19 In Russian

The introduction of a new process for the production of

aviation gasolines based on reformed gasoline has made it possible to optimize the quality of aviation gasolines with respect to their chemical stability tar content iodine number and the content of an antioxidizer. The principal properties of gasolines B 91/115 B 95/130, and B 100/130 are briefly reviewed. It is proposed to replace the aviation gasolines currently in use with a single gasoline type B 91/115 with an octane number of not less than 95.

A82 15723 † Optimization of requirements on the pitting-prevention properties of turbojet engine oils (Optimizatsiia trebo vanii k protivopittingovym svoistvam masel dlia turboreaktivnykh dvigatelei) B S Gutenev A V Vilenkin G T Novosartov V G Gorodetskii and B F Kirdakov Khimiia i Tekhnologiia Topliv i Masel no 11 1981 p 30 31 5 refs In Russian

Analysis of the operating conditions of bearings in turbojet engines shows that the probability of trouble free bearing service is reduced with increasing temperatures and loads. In order to increase the service life of turbojet engine bearings a study has been carried out with the aim of improving the pitting prevention properties of MS-8p oil. This objective has been achieved by substituting a chlorine containing additive for a phosphorus containing additive

VΙ

A82 15724 † Efficient use of working fluids in aviation hydraulic systems (Ratsional noe primenenie rabochikh zhidkostei v aviatsionnykh gidravlicheskikh sistemakh) B G Bedrik V S Ugriumov and A F lakovleva Khimiia i Tekhnologiia Topliv i Masel no 11 1981 p 33 35 In Russian

Changes in the quality of working fluids in the hydraulic equipment of aircraft in the process of equipment operation are analyzed. It is shown that by scheduling fluid replacement with allowance for the actual condition of the fluid it would be possible to reduce fluid consumption by 1 5 2 times without a tradeoff in equipment reliability.

A82 15748

A VHF homing system with VHF radio telephony for area representative strip-survey flights conducted, as part of combined forest inventories, with light aircraft carrying 70 mm and 35 mm cameras (Ein VHF Homing System mit VHF Sprechfunk für flachenreprasentative Streifenbefliegungen mit 70 mm und 35 mm Kameras von leichten Flügzeugen im Rahmen kombinierter Waldinventuren) B Rhody (Bundesforschungsanstalt für Forst und Holzwirtschaft Hamburg West Germany) Bild messung und Luftbildwesen vol 49 Nov 1 1981, p 199 203 In German

A82-15816 Computer animated predictive displays for microwave landing approaches S N Roscoe (New Mexico State University Las Cruces NM) and R S Jensen (Ohio State University Columbus OH) IEEE Transactions on Systems Man and Cybernet Ics vol SMC 11 Nov 1981 p 760 765 55 refs

It is shown that a safe, orderly and economical flow of air traffic at congested metropolitan airports can be ensured by microwave radio guidance systems. By furnishing aircraft position in three dimensions these terminal navigation aids potentially allow steeply curved landing approaches that will faciliate unprecedented noise abatement procedures large fuel savings and precisely timed arrivals at airport runways. To implement such complex flight procedures a combination of semiautomatic computer assisted air plane guidance and control and radically different flight displays will be required if pilots are to monitor such maneuvers confidently and execute them manually when necessary Results of a simulator investigation involving visual guidance and flight path prediction embedded in computer animated contact analog displays show that pilots can reliably execute computer programmed curved approaches to airport runways with the required precision in the face of severe wind shears CR

A82 15823 The influence of wind shear and vertical winds on takeoffs and go-arounds R Konig and P Krauspe (Braunschweig Technische Universität Braunschweig, West Germany) Airport Forum vol 11 Oct 1981 p 43-46 8 refs

The effects of wind shear and vertical winds on aircraft takeoffs

and go arounds is discussed. It is noted that with the advent of a more modern autopilot generation and advanced wind shear warning indicators. landing accidents due to wind shear will be avoidable. Hazards posed by low velocity downdrafts and wind shear in the lee of a large-surface obstacle are also considered with reference to studies made a a German airport and with simulators. Operational considerations of wind shear are assessed.

A82 15824 'In situ' composites for jet propulsion and stationary gas turbine applications W Bunk (Deutsche Forschungs und Versuchsanstalt für Luft und Raumfahrt Institut für Werkstoff Forschung Cologne Aachen Rheinisch Westfalische Technische Hochschule Aachen West Germany) and P R Sahm (Aachen, Rheinisch Westfalische Technische Hochschule Aachen West Germany) Zeitschrift für Werkstofftechnik vol 12, Oct 1981 p 345 359 25 refs Research supported by the Bundesministerium für Forschung und Technologie

Examples of reinforced superalloys for high temperature applications in jet engines are reported. The phase stability of microstruc tures is tested with a high thermal gradient device, and first engine tests of directionally solidified Co Cr7C3 eutectic alloy are reported. Properties such as creep behavior, fatigue, and oxidation resistance are measured and compared with corresponding data for both conventionally and directionally cast Ni base superalloy IN 738. First engine tests of 18 000 hrs with unalloyed Co Cr7C3 vanes indicate the importance of a fully eutectic microstructure and stability against carbide transformations.

A82 15827 Rapid elliptic solvers R W Hockney (Reading, University Reading Berks , England) In Numerical methods in applied fluid dynamics London and New York, Academic Press 1980 p 1 48 37 refs

Rapid direct methods for the solution of certain classes of elliptic partial differential equations (pde) have been in use for over ten years. Such methods are based on Fourier analysis, cyclic reduction and optimal combinations of the two. To classify as a Rapid Elliptic Solver (RES), the algorithm must solve the elliptic equation of an (n x n) mesh in a number of floating-point arithmetic operations which corresponds approximately to the source of n. The methods are also characterized by the minimum use of storage. A number of different RES algorithms for the solution of pde's are considered taking into account questions concerning the choice of algorithm the method of Fourier Analysis and Cyclic Reduction (FACR), the cyclic reduction process marching methods and a comparison of programs. Attention is also given to nonseparable equations and the N body problem.

A82 15835 Remarks on the calculation of transonic potential flow by a finite volume method. A Jameson (New York University New York NY) In Numerical methods in applied fluid dynamics London and New York Academic Press, 1980 p. 363 386 18 refs. Contract No. N00014 77 C-0032

The development of a finite volume method for the numerical calculation of transonic flow is considered. It is assumed that the flow is irrotational so that the velocity can be represented as the gradient of a potential. Essentially this limits the application of the method to flows containing fairly weak shock waves for which the Mach number of the normal component of the velocity ahead of the shock is not substantially greater than 1.3 since shock waves are to be modelled by isentropic jumps. The formulation of the equations is discussed taking into account the case of a wing or wing body combination in a uniform stream. The discrete approximation to the equations is developed by using a subdivision of the domain into distorted cubic cells. The developed procedure is applied to the study of swept wings. The results of the calculations encourage confidence in the usefulness of the potential flow model for engineering predictions.

A82 15845 # Robust flight control A design example S N Franklin (Systems Control Technology Inc Palo Alto CA) and J Ackermann (Deutsche Forschungs und Versuchsanstalt für Luft- und Raumfahrt, Institut für Dynamik der Flugsysteme Oberpfaffen hofen, West Germany) Journal of Guidance and Control vol 4 Nov Dec 1981, p 597 605 6 refs Research supported by the

Deutsche Forschungs und Versuchsanstalt für Luft und Raumfahrt Grant No AF AFOSR 78 3633 Contract No N00014 79 C 0424

A novel parameter space method is used as a tool for the design of a robust stabilization system for the short period longitudinal mode of a fighter aircraft. The example is an F 4E with additional horizontal canards. Robustness is achieved in the sense that military specifications for damping and natural frequency are satisfied by a constant controller in spite of perturbations. The perturbations are changing flight conditions and undetected sensor failures. The resulting controller structure requires two gyros and one accelero meter. The system including actuator dynamics and feedback dynamics is of sixth order and in the design, four free controller parameters have been assumed. Practical considerations are taken into account such as bandwidth limitation below structural vibration frequencies actuator limitations, and relaxed emergency specifications in failure situations.

A82 15846 4 Airplane performance sensitivities to lateral and vertical profiles J C Wauer J M H Bruckner (Rockwell International Corp Cedar Rapids IA) and C H Humphrey (United Air Lines Inc San Francisco CA) Journal of Guidance and Control vol 4 Nov Dec 1981 p 606 613 11 refs

Airplane performance sensitivity to the choice of lateral and vertical profiles is studied based on data recorded on in service flights of a 727 200 airplane equipped with JT9D 7 engines. Lateral profile performance sensitivity is based on analysis of flight technical or guidance error and on varying degrees of direct flight clearance. Vertical analysis is based on an aerodynamic simulation of the recorded flights. Sensitivity to the choice of vertical profile is studied by simulating the actual profile that was flown two perfectly flown constant IAS/Mach profiles and minimum cost and minimum fuel optimum profiles. Some of the practical considerations in imple menting the real time optimum profile algorithms and some of the difficulties encountered with the optimum profile computations are discussed. Predicted fuel and time savings are related to the air traffic control (ATC) environment experienced by the airlines to obtain net savings predictions with varying degrees of ATC restriction. (Author)

A82 15847 * # Experimental evaluation of a perspective tunnel display for three dimensional helicopter approaches A J Grunwald (Technion Israel Institute of Technology Haifa Israel) J B Robertson and J J Hatfield (NASA Langley Research Center Flight Electronics Div Hampton VA) Journal of Guidance and Control vol 4 Nov Dec 1981 p 623 631 11 refs

A computer generated perspective tunnel display for a steep and strongly curved three dimensional helicopter approach is studied. The necessary control variables for following a curved trajectory are analyzed the effectiveness of superimposed predictor symbology is investigated and a suitable predictor law is formulated. The theoretical considerations are validated by an extensive fixed base simulator program. The tunnel display with a superimposed predictor symbol is shown to outperform conventional type displays in its abilities to follow a curved trajectory in the presence of gust disturbances to enter the trajectory from an unknown position outside this trajectory as well as to monitor automatic approaches. The feasibility of the tunnel display for operation in actual flight has been demonstrated in an exploratory flight test. (Author)

A82 15864 Mathematical programming in engineering design problems H J Baier (Dornier System GmbH Friedrichshafen West Germany) In Numerical optimisation of dynamic systems Amsterdam, North Holland Publishing Co

The application of mathematical programming to engineering design problems is considered. After the statement of the problem some real world applications are discussed and some comments on the impact of mathematical programming on the engineering design process are made. Sequential unconstrained minimization technique, sequential linear programming and Lagrangian multiplier methods are presented as three important representatives of optimization algorithms in this field of application. The discussion of some special features shows what can be undertaken to improve their relative performance. Finally an assessment of these algorithms is made.

(Author)

A82 15918 # High voltage/high power for airborne applications F C Brockhurst (USAF Institute of Technology Wright Patterson AFB, OH) and M P Dougherty (USAF Aero Propulsion Laboratory Wright Patterson AFB OH) IEEE Transactions on Aerospace and Electronic Systems vol AES 17 Nov 1981 p 795-801 15 refs

Advancements made in technologies required for lightweight high voltage, high power airborne power systems are discussed Programs to reduce the weight of rotating machines transformers, switches, inverters and capacitors are described and some aspects in the use of these components in the design of lightweight systems are considered Interactive programs already developed allow the design or to analyze circuit performance and perform component and limited system design while additional programs are planned with emphasis on quick response ease of use, and versatility DLG

A82 15950 CT7 GE attacks commuter turboprop mar ket J Moxon Flight International vol 120 Nov 21 1981 p 1572 1575, 1576

A description is given of the design features and performance capabilities of the CT7 turboprop engine which is intended for commuter aircraft of the 30 35 seat class. The 1700 shaft horse power engine employs a combined axial/centrifugal compressor to achieve a pressure ratio of 17 1 and turbine entry temperatures of over 1200 C. Emphasis is put on the engine's maintainability which allows field changes of all modules with only a 12 piece standard tool kit. It is claimed that the CT7 engine core is 30% more fuel efficient than the CT58 helicopter engine core which it is scheduled to replace. The engine incorporates a centrifugal inlet separator that rejects 85 95% of all sand and dust. The reliability of the CT7 is in part due to the development and operational experience accumulated with the T700 military turboshaft on which its design is based. O.C.

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STAR ENTRIES

N82-12030 Air Force Inst of Tech., Wright-Patterson AFB, Ohio

THE NUMERICAL SOLUTION OF INCOMPRESSIBLE TURBULENT FLOW OVER AIRFOILS Ph.D Thesis

Harwood Allan Hegna 1981 168 p

Avail Univ Microfilms Order No 8119139

An algebraic eddy viscosity turbulence model based on Prandtl's mixing length theory was modified for separated adverse pressure gradient flows. Finite difference methods for solving the inviscid stream function equation and the incompressible laminar Navier-Stokes equations were used. A finite difference method for solving the Reynolds averaged incompressible turbulent two-dimensional Navier-Stokes equations were employed. Solutions for a NACA 0012 airfoil at angles of attack varying from five to 115 degrees at a chord Reynolds number of 170 000 were obtained. Velocity profiles near the airfoil surface and surface pressure distributions are presented and compared with experimental data. Lift and drag coefficients agree well with experimental values.

N82-12031 Arizona Univ. Tucson SUBCRITICAL AND SUPERCRITICAL AIRFOILS FOR GIVEN PRESSURE DISTRIBUTION Ph.D. Thesis

Ahmed Abdelatif HassanEissa 1981 82 p Avail Univ Microfilms Order No 8121930

An effective method, based on hodograph theory, was developed for the aerodynamic design of subcritical and shock-free supercritical airfoil sections. In addition to the free-stream conditions, the input to the design procedure includes a prescription of the subsonic part of a target pressure distribution and, for supercritical airfoils, of a presumed stream function on the sonic line. A computer program carries out a number of sequential steps that result in an airfoil with a pressure distribution close to that desired at little computational cost. Thus, the airfoil designer can alter the input if design goals are not met and quickly produce another candidate airfoil. This is aided by appropriate graphic display of the airfoil and its pressure distribution.

N82-12041*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

AEROELASTICITY MATTERS: SOME REFLECTIONS ON TWO DECADES OF TESTING IN THE NASA LANGLEY TRANSONIC DYNAMICS TUNNEL

Wilmer H Reed, III Sep 1981 19 p refs Presented at the Intern Symp on Aeroelasticity, Nuremberg, West Germany, 5-7 Oct 1980 - 1 Oct 1981

(NASA-TM-83210) Avail NTIS HC A02/MF A01 CSCL 01A

Testing of wind-tunnel aeroelastic models is a well established. widely used means of studying flutter trends, validating theory and investigating flutter margins of safety of new vehicle designs The Langley Transonic Dynamics Tunnel was designed specifically for work on dynamics and aeroelastic problems of aircraft and space vehicles. A cross section of aeroelastic research and testing in the facility since it became operational more than two decades ago is presented. Examples selected from a large store of experience illustrate the nature and purpose of some major areas of work performed in the tunnel. These areas include. specialized experimental techniques, development testing of new aircraft and launch vehicle designs, evaluation of proposed 'fixes' to solve aeroelastic problems uncovered during development testing, study of unexpected aeroelastic phenomena (i.e., 'surprises'), control of aeroelastic effects by active and passive means and, finally, fundamental research involving measurement of unsteady pressures on oscillating wings and control surface

ARH

N82-12042*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

EXPERIMENTAL AND ANALYTICAL STUDIES OF A MODEL HELICOPTER ROTOR IN HOVER

F X Caradonna and C Tung Sep 1981 61 p refs Presented at the 6th European Rotorcraft and Powered Lift Aircraft Forum, Bristol, England, 16-19 Sep 1980 Prepared jointly with Army Aviation Research and Development Command

(NASA-TM-81232, A-8332, USAAVRADCOM-TR-81-A-23) Avail NTIS HC A04/MF A01 CSCL 01A

A benchmark test to aid the development of various rotor performance codes was conducted. Simultaneous blade pressure measurements and tip vortex surveys were made for a wide range of tip Mach numbers including the transonic flow regime. The measured tip vortex strength and geometry permit effective blade loading predictions when used as input to a prescribed wake lifting surface code it is also shown that with proper inflow and boundary layer modeling, the supercritical flow regime

can be accurately predicted

N82-12047# ARO, Inc., Arnold Air Force Station, Tenn EVALUATION AND WIND TUNNEL TESTS OF THE 4,000 LB (NORMAL-FORCE) PITCH/YAW AND ROLL DYNAMIC STABILITY BALANCE SYSTEMS FOR MEASURING DIRECT, CROSS, AND CROSS-COUPLING DERIVATIVES Final Report, 5 Jun. 1978 - 25 May 1979

Report, 5 Jun. 1978 - 25 May 1979

T D Buchanan, S M Coulter and E J Marquart Sep 1981
79 p refs

(AD-A105122 AEDC-TR-80-12) Avail NTIS HC A05/MF A01 CSCL 20/4

Early in the 1970's, the personnel at the Arnold Engineering Development Center (AEDC) recognized the need for a set of new dynamic test mechanisms for testing aircraft models at high angles of attack At these angles of attack cross and cross-coupling derivatives may be significant in determining the aircraft's stability. Dynamic balances were fabricated to perform pitch, yaw, and roll dynamic stability tests of aircraft or large missile models at AEDC. The balances were designed to measure not only the direct derivatives but also cross and cross-coupling derivatives. The set of balances comprises a 4,000-lb (normalforce) roll and a 4 000-lb pitch/yaw forced-oscillation balance to measure the direct damping derivatives and a five-component can-type balance to measure the cross and cross-coupling derivatives attributable to pitch or yaw Extensive laboratory investigations of the balances' static and dynamic response characteristics were performed before wind tunnel tests of a 1/9-scale F-16A model in the AEDC Propulsion Wind Tunnel (16T) at Mach numbers from 0.2 to 1.4

N82-12050 APPLICATION OF SINGULAR PERTUBATION THEORY TO ONBOARD AIRCRAFT TRAJECTORY OPTIMIZATION Ph D Thesis

Abhijit J M Chakravarty 1981 139 p

Avail Univ Microfilms Order No 8121183

The problem of minimizing direct operating cost in dollars (combined cost per hour and cost of fuel per hour) for a typical commercial jet transport model is formulated via the Pontryagin minimum principle. Singular perturbation theory is applied to reduce the computational burden of solving the resulting optimal control problem. The work of p. vious investigators is extended to include the aircraft weight v riation in the state equations and the resulting seven-state midel is analyzed for time scale separation It is shown that a lealistic time scale separation involves only two scales. The resulting model is then used to develop the inner and outer solutions as dictated by singular perturbation theory. Both the free terminal time problem and the time controlled 4-D problem are considered. A comprehensive model for the aerodynamic and fuel flow terms appearing in the equations is developed for use in optimal trajectory computation Numerical results are presented that illustrate the nature of the optimal trajectory and the control variables Dissert Abstr

N82-12051*# Virginia Univ Charlottesville School of Engineering and Applied Science

TRANSPORTATION SYSTEMS EVALUATION METHODOL-OGY DEVELOPMENT AND APPLICATIONS, PHASE 3 Final Report

A Robert Kuhlthau I D Jacobson, and L C Richards Jun 1981 82 p (Contract NAS1-14908)

(NASA-CR-164999, UVA/528175/MAE-CE81/101) Avail NTIS HC A05/MF A01 CSCL 01B

Transportation systems or proposed changes in current systems are evaluated. Four principal evaluation criteria are incorporated in the process, operating performance characteristics as viewed by potential users, decisions based on the perceived impacts of the system, estimating what is required to reduce the system to practice, and predicting the ability of the concept to attract financial support. A series of matrix multiplications in which the various matrices represent evaluations in a logical sequence of the various discrete steps in a management decision process is used. One or more alternatives are compared with the current situation, and the result provides a numerical rating which determines the desirability of each alternative relative to the norm and to each other. The steps in the decision process are isolated so that contributions of each to the final result are readily analyzed. The ability to protect against bias on the part of the evaluators, and the fact that system parameters which are basically qualitative in nature can be easily included are advantageous

N82-12052*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

INVESTIGATION OF SEVERE LIGHTNING STRIKE IN-CIDENTS TO TWO USAF F-106A AIRCRAFT

J Anderson Plumer Hampton, Va NASA Langley Research Center Sep 1981 19 p (Contract NAS1-15884)

(NASA-CR-165794, LT-80-56) Avail NTIS HC A02/MF A01

CSCL 01C

The results of the inspection and analysis of two F-106A aircraft that were struck by separate lightning strikes within a few minutes of each other are presented. Each aircraft sustained severe lightning strikes to the pitot booms, resulting in extensive damage to the pitot heater power harness, number 8 ground wire, and lightning suppressors, but there was no damage to either aircraft's electrical or avionic systems. A simulated lightning current of 226 kA and 38 million A(2)*S was required to reproduce the damage to the ground wires in the radomes Photographs and detailed assessments of the damage are

N82-12053# Federal Aviation Administration, Washington, D.C. Office of Aviation Medicine

AN ANALYSIS OF CIVIL AVIATION PROPELLER-TO-PERSON ACCIDENTS. 1965-1979

William E Collins, Angelo R Mastrullo, William R Kirkham, Deborah K Taylor and Paula M Grape May 1981 13 p refs Avail (AD-A105365, FAA-AM-81-15) HC A02/MF A01 CSCL 01/2

The interest of manufacturing, governmental, and safety personnel using paint schemes on propeller and rotor blades is based on improving the visual conspicuity of those blades when they are rotating. While propeller and rotor paint schemes may serve to reduce the number of fatalities and injuries due to contact with a rotating blade there is little information available regarding analyses of the circumstances surrounding such accidents Brief reports provided by the National Transportation Safety Board of all 'propeller-to-person' accidents from 1965 through 1979 were examined and analyzed in terms of airport lighting conditions, actions of pilots, actions of passengers and ground crew, phase of flight operation weather conditions and others Analyses based on a total of 319 accidents showed a marked drop in the frequency of 'propeller-to-person accidents from 1975 through 1978 Several types of educational efforts directed toward pilots and ground crew, both prior to and during that 4-year period were examined as possible factors contributing to the accident rate decline. Accident patterns provide a basis for assessing the probable efficacy of various recommendations (including propeller conspicuity) for further reducing 'propeller-toperson' accidents Author (GRA)

N82-12054# Federal Aviation Administration, Washington D C Office of Aviation Safety

COMPUTER AIR CARRIER SYMPOSIUM

16 Jan 1981 248 p refs Symp held at Washington, D.C., 15-16 Jan 1981

(AD-A104894. FAA-ASF-300-81-6) Avail HC A11/MF A01 CSCL 01/2

Partial Contents Working Session I -- Simulation, Fitness,

and Safety Analysis, Working Session II -- Airports and Airways, and Working Session III -- Human Factors

N82-12055# Federal Aviation Administration, Washington, D.C. Office of Aviation Safety

SUMMARY OF FEDERAL AVIATION ADMINISTRATION RESPONSES TO NATIONAL TRANSPORTATION SAFETY BOARD SAFETY RECOMMENDATIONS Quarterly Report, Jan. - Mar 1981

R E Livingston and C A Carpenter Apr 1981 243 p refs (AD-A104922 FAA-ASF-81-3) HC A11/MF A01 CSCL 01/2

This report contains NTSB recommendations and all FAA responses to Board recommendations that were delivered to the Board during the applicable quarter. In addition, the report includes NTSB requests and FAA responses concerning reconsiderations, status reports, and followup actions. The Table of Contents for this report reflects only those NTSB recommendations which are still open pending FAA action (i.e., those that have not been designated as 'Closed' by the NTSB as a result of acceptable action) Accordingly, the Table of Contents may reflect a number of multiple recommendations (example A-79-21 through 24), but background material is included only for those recommendations which remain in an 'Open status Background information for those recommendations which have been closed is available in FAA Headquarters files Author (GRA)

N82-12056# Federal Aviation Administration Atlantic City, NJ Technical Center

INDEX OF NATIONAL AVIATION FACILITIES EXPERIMEN-TAL CENTER TECHNICAL REPORTS 1972 - 1977 Report, 1972 - 1977

Ruth J Farrell comp and Nancy G Boylan, comp May 1981 201 p

(FAA Proj 999-113-000)

(AD-A104759 FAA-CT-81-54) NTIS Avail HC A10/MF A01 CSCL 01/3

This report is an index of all technical reports which were assigned NA numbers and published by NAFEC during the period 1972 through 1977 Entries are arranged by NA number and include titles, authors and full abstracts. Separate sections contain indexes by subject, author, and RD number Author (GRA)

N82-12057# Textron Bell Helicopter, Fort Worth, Tex INVESTIGATION OF THE STRUCTURAL DEGRADATION AND PERSONNEL HAZARDS RESULTING FROM HELICOP-TER COMPOSITE STRUCTURES EXPOSED TO FIRES AND/OR EXPLOSIONS Final Report, Mar. 1979 - Dec. 1980

Raymond J Schiltz, Jr Aug 1981 111 p refs (Contract DAAK51-79-C-0009, DA Proj 1L1-62209-AH-76) (AD-A104757, USAAVRADCOM-TR-81-D-16) Avail NTIS HC A06/MF A01 CSCL 13/12

A program was undertaken to investigate the structural degradation and personnel hazards resulting from exposure of helicopter composite structures to fire and/or explosion. The program consisted of a technical survey, a test program, and an analysis phase. A major part of the technical survey was a literature survey. In addition, organizations working in the fields of interest were contacted for information and some were visited for further, detailed discussions. The computer programs currently available for modeling enclosure fires were screened, and one was chosen for further study. The test program consisted of a series of tests on two representative helicopter structures a sheet-stiffened, built-up door of Kevlar 49 fabric impregnated with an epoxy resin, and a honeycomb sandwich fuselage shell structure of graphite/epoxy fabric skins on a Nomex honeycomb core The tests conducted on materials from these structures were smoke generation tests, and structural degradation tests Ballistic tests on the complete test article were conducted to determine whether the structures would ignite under HEI impact conditions Based on the survey and testing, design criteria for struct ral composite components were investigated and, when appropriate, formulated Author (GRA)

N82-12059# Federal Aviation Administration, Atlantic City, NJ FLIGHT EVALUATION OF LORAN-C AS A HELICOPTER NAVIGATION AID IN THE BALTIMORE CANYON OIL EXPLORATION AREA Final Report, Mar. - May 1979 William A Lynn May 1981 43 p

(FAA Proj 045-390-130) (AD-A105260, FAA-CT-80-53, FAA-RD-81-27) Avail NTIS HC A03/MF A01 CSCL 17/7

A series of flight tests were conducted to investigate the use of long range navigation (LORAN)-C as a helicopter navigation system in the offshore New Jersey Baltimore Canyon oil exploration area. Tests were flown aboard the Federal Aviation. Adminstration (FAA) Technical Center's CH-53A using a Teledyne Systems TDL-711 LORAN Micro-Navigator The purpose of the tests was to determine the accuracy and operational usability of LORAN-C for offshore en route navigation and nonprecision approaches The total system accuracy met or exceeded the requirements of Advisory Circular (AC) 90-45A 'Accuracy Requirements of Area Navigation Systems' for terminal and en route phases of flight, provided the proper LORAN triads were selected The LORAN-C System did not meet AC 90-45A nonprecision approach accuracy criteria Author (GRA)

N82-12060# Federal Aviation Administration, Atlantic City, NJ Technical Center

THE USE OF GROUNDSPEED, IN A WIND SHEAR AND THE FLIGHT EVALUATION OF A RADAR-ALTIMETER-BASED SYSTEM FOR THE MEASUREMENT OF GROUND-SPEED Final Report, Jan. 1978 - Oct. 1980

David Lawrence Jul 1981 44 p refs
(AD-A104758, FAA-CT-81-34, ACT-100F) Avail NTIS

HC A03/MF A01 CSCL 04/2

The use of groundspeed in combination with airspeed has been considered and shown to be an effective aid in the execution of an approach and landing in a heavy jet transport airplane. A flight dynamics analysis shows that the response of such aircraft to sudden changes in headwind is quite sluggish, requiring more than 100 seconds for equilibrium conditions to be regained in the worst case A feasibility demonstration model of a radaraltimeter-based system for the measurement of groundspeed has been subjected to a limited in-flight evaluation. It is a selfcontained unit requiring no ground-based equipment and no on-board equipment other than the small flush transmit and receive antennas and the associated cable runs. While the current unit does not meet the desired accuracy standard (delta = +or 3 knots, or less), it approaches it at times, and greater accuracy can be achieved with further development. Responsiveness to rapidly changing groundspeed matched that of the reference inertial navigation system, and satisfactory groundspeed tracking was maintained during turning, climbing, and descending flight Author (GRA)

N82-12061# Ohio Univ , Athens Dept of Electrical Engineer-

PERFORMANCE ASSESSMENT, VOLUME 1: EVALUATION PROCEDURES AND EQUIP-MENT DESIGN Final Report

Robert W Lilley, Richard H McFarland, and Walter D Phipps Dec 1980 83 p refs

(Contract DOT-FA79NA-6030)

(AD-A105393, EER-47-2-Vol-1, FAA-CT-81-50-Vol-1) Avail NTIS HC A05/MF A01 CSCL 17/7

Preliminary flight-check procedures and system tolerances for the Microwave Landing System (MLS) are presented A data-collection and recording package for use in light-aircraft measurement of MLS parameters in support of the System Test and Evaluation Program (STEP) is included containing a ground reference system, digital telemetry link airborne MLS sensor unit and system computation/display element Author (GRA)

N82-12062# Teledyne Systems Co., Northridge, Calif DESIGN STUDY REPORT FOR GENERAL AVIATION LORAN-C RECEIVER Final Report

H L Walker and R Ellerbe May 1981 257 p

(Contract DT-FA01-80-C-10108)

(AD-A104921. FAA/RD-81/36) NTIS

HC A12/MF A01 CSCL 17/7

This document summarizes the results of studies and trade-off analysis conducted for a low cost Loran-C Receiver The Loran-C Receiver is intended to meet the Minimum Operational Performance Standards for area Navigation (RNAV) equipment for General Aviation Aircraft operating in the National Aerospace System The studies and analysis examined the required receiver performance, design approaches and design criteria. and cost to the user of the receiver. The study concludes that a low cost receiver meeting the General Aviation RNAV requirements is practical. A design approach for the receiver is described Author (GRA)

N82-12063# Technische Hogeschool, Delft (Netherlands) ORIENTING DESCRIPTION OF AIR TRAFFIC CONTROL IN THE NETHERLANDS [ORIENTERENDE BESCHRIJVING VAN DE LUCHTVERKEERSLEIDING IN NEDERLAND]
W H vanTuijl Aug 1979 84 p refs in DUTCH
(VTH-LR-285) Avail NTIS HC A05/MF A01

A general impression is given of air traffic control (ATC) in the Netherlands and of the signal automatic radar data processing (SARP) air traffic control system for Schiphol airport emphasizing safety and efficiency. Flight conditions, air structure, and navigation and landing aids of the ATL system are described. In the SARP system, data relative to position and flight plans are, on a real time basis, processed by a set of computers and distribued Task sharing in SARP, its technical layout, its operational layout, operational functions and flight data are reviewed. Author (ESA)

N82-12064# National Aerospace Lab , Amsterdam (Netherlands)

THE EFFECT OF VISUAL INFORMATION ON MANUAL APPROACH AND LANDING

P H Wewerinke 28 Apr 1980 20 p refs Presented at 16th Ann Conf on Manual Control, Cambridge, Mass. 5-7 May 1980 Abbreviated version of NLR-TR-80055-U (NLR-MP-80019-U, NLR-TR-80055-U)

HC A02/MF A01

The effect on approach performance of visual scene information, in combination with basic display information, is discussed for the manual approach and landing task. Good, poor, and night visibility conditions are considered, combined with basic head-up display configurations representing a variety of visual cues (runway contours, etc.) A pre-experimental model analysis was performed in terms of an optimal control model. The resulting aircraft approach performance predictions were compared with the results of a moving base simulator program. The results illustrate that the model provides a meaningful description of the visual (scene) perception process involved in the complex (multivariable, time varying) manual approach task with a useful predictive capability. The theoretical framework is shown to allow a straight forward investigation of the complex interaction of a variety of task variables Author (ESA)

N82-12065*# Foster-Miller Associates, Inc., Waltham, Mass EXPERIMENTAL AND ANALYTICAL STUDIES OF AD-VANCED AIR CUSHION LANDING SYSTEMS Final Report

E G S Lee, A B Boghani, K M Captain, H J Rutishauser, H L Farley, R B Fish, and R L Jeffcoat' Washington NASA Nov 1981 188 p refs (Contract NAS1-15051)

(NASA-CR-3476) Avail NTIS HC A09/MF A01 CSCL 01C Several concepts are developed for air cushion landing systems (ACLS) which have the potential for improving performance characteristics (roll stiffness, heave damping, and trunk flutter). and reducing fabrication cost and complexity After an initial screening, the following five concepts were evaluated in detail damped trunk, filled trunk, compartmented trunk, segmented trunk, and roll feedback control. The evaluation was based on tests performed on scale models. An ACLS dynamic simulation developed earlier is updated so that it can be used to predict the performance of full-scale ACLS incorporating these refinements. The simulation was validated through scale-model tests A full-scale ACLS based on the segmented trunk concept was fabricated and installed on the NASA ACLS test vehicle, where it is used to support advanced system development. A geometrically-scaled model (one third full scale) of the NASA test vehicle was fabricated and tested. This model, evaluated by means of a series of static and dynamic tests, is used to investigate scaling relationships between reduced and full-scale models. The analytical model developed earlier is applied to simulate both the one third scale and the full scale response

N82-12066# Aeronautical Research Labs , Melbourne (Australia) FLIGHT TRAIL OF THE AIRCRAFT FATIGUE DATA ANALYSIS SYSTEM (AFDAS) Mk 2 PROTOTYPE

P J Howard Dec 1980 37 p refs (AD-A105270, ARL/STRUC-NOTE-466, AR-002-249) NTIS HC A03/MF A01 CSCL 01/3

A prototype version of the Aircraft Fatigue Data Analysis System (AFDAS) has been evaluated in flight trials by a comparison with continuously recorded data. Over a limited period of test the range-mean-pairs count of strain cycles was the same for both sets of data, and the gains calculated for the AFDAS are identical to those deduced from the continuous record.

Author (GRA)

N82-12067# General Electric Co., Binghamton, N.Y. Aircraft Equipment Div

ELECTRONIC MASTER MONITOR AND ADVISORY DISPLAY SYSTEM (EMMADS) Final Report, Jun. 1977 - Jun. 1981

Jun 1981 38 p refs

(Contract DAAK80-79-C-0270, DA Proj 1L2-62202-AH-85) (AD-A105082, ACS-12386, USAAVRADCOM-TR-79-F-270) Avail NTIS HC A03/MF A01 CSCL 01/3

The design and fabrication of a programmable feasibility model of an electronic master monitor and advisory display system for helicoptrs is described. Functional requirements and system interfaces for signal analysis were determined for the helicopters studied. Human factors studies developed formats for reducing crew workloads and maximizing crew performance. Methods of data transfer from sensors to the monitor system were analyzed and appropriate interfaces and data transmission media were recommended. The programmable feasibility model is discussed.

N82-12069# Aeronautical Research Labs, Melbourne (Australia) A VAPOUR CYCLE CABIN COOLING SYSTEM FOR THE SEA KING MK.50 HELICOPTER

Brian Rebbechi Feb 1980 59 p refs (AD-A105211, ARL/MECH-ENG-155, AR-001-793) Avail NTIS HC A04/MF A01 CSCL 13/1

An experimental determination has been made of the design requirements for a cabin cooling system in the Sea King Mk 50 helicopter. The purpose of this system is to bring the cabin environment in the helicopter to an acceptable level for effective crew performance. Cooling was provided by an experimental vapour cycle cooling system. Results of the trials have been used to formulate a heat transfer model of the cabin to enable prediction of required cooling capacity for extreme climatic conditions. A comparison, based on the trials results, is made between the performance attainable by a vapour cycle cooling system, and an air cycle system using the available engine bleed.

Author (GRA)

N82-12070# Hochschule der Bundeswehr, Munich (West Germany) Flugmechanik und Flugfuehrung

EFFECTS OF AERODYNAMIC COUPLING ON THE DYNAM-ICS OF ROLL AIRCRAFT

Gottfried Sachs and Werner Fohrer Jan 1981 48 p refs In GERMAN, ENGLISH summary Avail NTIS HC A03/MF A01

The effects of coupling of longitudinal and lateral aerodynamic characteristics on the dynamics of aircraft roll were studied, using simplified relations and complete six-degree of freedom calculations. The aerodynamic coupling is caused by unsymmetric flow conditions resulting from sideslipping, where rolling moments due to angle of attack and pitching moments due to angle of sideslip, are of particular significance for the problem. It is shown that the attainable rate of roll is significantly influenced and that marked effects on stability are possible. Furthermore, it is shown that aerodynamic coupling can cause autorotation, i.e., a rolling motion without alleron forcing moments. Author (ESA)

N82-12072# Engins Matra, Velizy (France) Lab Central ADVANTAGES AND LIMITATIONS OF VARIOUS MATERIALS USED IN THE CONSTRUCTION OF MODULES [ATOUT ET LIMITES D'EMPLOIS DES DIVERS MATERIAUX UTILISES DANS LA CONSTRUCTION DES CELLULES]

G Hilaire 30 Jul 1981 39 p In FRENCH Presented 9th Colloq Aciers et Alliages Speciaux dans les Ind Aerospatiales, Le Bourget, France, 11 Jun, 1981

(SNIAS-812-551-103, C-42796) Avail NTIS HC A03/MF A01

Steels, light alloys, titanium alloys, and composites are compared for economy, mechanical characteristics, energy content, fatigue effects and toughness. The use of these materials in civil and military aircraft, helicopters, and engines is surveyed Increasing use of composites is forecast for the next decade, with a corresponding drop in the use of light alloys. Steels and titanium alloys should not be affected. Author (ESA)

N82-12074# Air Force Flight Test Center, Edwards AFB, Calif Flight Dynamics Div

AFFTC STANDARD AIRSPEED CALIBRATION PRO-CEDURES Final Report

Albert G DeAnda Jun 1981 162 p refs

(AD-A104830 AFFTC-TIH-81-5) Avail NTIS HC A08/MF A01 CSCL 01/4

This handbook has been compiled as a reference for use by AFFTC flight test engineers in the standard flight test methods, techniques and procedures for airspeed calibrations. Suggested airspeed calibration data reduction methods are presented. Some of the information included in this reference applies to the local AFFTC facilities, however, the data reduction outlines are for general application.

Author (GRA)

N82-12075*# General Electric Co., Lynn, Mass Aircraft Engine Group

EFFECT OF A PART SPAN VARIABLE INLET GUIDE VANE ON TF34 FAN PERFORMANCE Final Report

Jose Alvarez and Paul W Schneider Sep 1981 133 p refs (Contract NAS3-21624)

(NASA-CR-165458, R81AEG030) Avail NTIS HC A07/MF A01 CSCL 21E

Experimental aerodynamic and performance data were obtained from a TF34 engine Part span variable inlet guide vanes mounted in front of the fan on the TF34 engine were tested to demonstrate the feasibility of modulating air flow and thrust for vertical takeoff aircraft systems. The fan was mapped to stall for a range of speeds and variable inlet guide were settings. Modulated fan tip performance and unmodulated hub performance were evaluated with a without an extended fan bypass splitter. The effect of a crosswind distortion screen on performance was also evaluated.

N82-12076# Aeronautical Research Labs , Melbourne (Australia) Mechanical Engineering Dept

VIBRATION TEST PROCEDURES FOR ACCESSORY ANGLE DRIVE GEARBOXES ON ATAR 09C ENGINES

P D McFadden and D H Edwards Mar 1981 57 p refs (AD-A105269, ARL/MECH-ENG-TM-408, AR-002-264) Avail NTIS HC A04/MF A01 CSCL 21/5

The Accessory Angle Drive gearbox powers the fuel and hydraulic pumps on the Atar engine in the Mirage aircraft. To insure against in-flight failure, each gearbox is vibration tested under load after overhaul by the local contractor. A new vibration testing technique, offering greatly improved accuracy and reliability, has been developed. The technique uses a real-time, fast-fourier spectrum analyzer, with direct digital read-out in engineering units, and a tracking adapter with built-in antialiasing filter. This report defines correct procedures for the connection and operation of the instruments, and the interpretation of the results.

N82-12077# Lucas Group Services Ltd., Solihull (England) THE USE OF METAL FINISHING IN AIRCRAFT FUEL SYSTEMS

S L Forgham and H L Tulloch 1981 28 p refs Avail NTIS HC A03/MF A01

Topics discussed are (1) corrosion resistant finishes. (2) finishes to aid manufacture. (3) repair and overhaul, and (4) bearing finishes. In the case of (1) hydrogen embritlement is identified as a major problem and processes generating hydrogen at the surface should be closely controlled. Results on drawing size of cadmium plating of rotor blades are presented. Various techniques of electrodepositing are compared. Pump rig tests on fuels containing chlorides, showing the effect on torque of additives after a 5 hr run and an additional 16 hr standing, are reported.

N82-12078# European Space Agency, Paris (France) THREE DIMENSIONAL FLOW INVESTIGATION WITH A METHOD OF CHARACTERISTICS IN THE INLET REGION

METHOD OF CHARACTERISTICS IN THE INLET REGION AND THE BLADE-TO-BLADE CHANNELS OF SUPERSONIC AXIAL COMPRESSORS Ph D Thesis - Paris Univ 6

Jean Martinon Sep 1981 341 p refs Transl into ENGLISH of 'Etude, au moyen d'une methode de bicaracteristiques, de l'ecoulement tridimensionnel dans la region d'entree et les canaux interaubes d'une roue de compresseurs axiaux supersoniques', ONERA, Paris Report ONERA-P-1979-1, 1979 Original report in FRENCH previously announced as N80-23325

(ESA-TT-637, ONERA-P-1979-1) Avail NTIS

HC A15/MF A01

A three dimensional method of characteristics is developed for the calculation of the supersonic flow in the inlet region and the blade-to-blade channels of blade cascades and high transonic axial flow compressors with subsonic or supersonic axial velocity. The numerical scheme is accurate, and required computer times are short. Results of calculations on several linear or annular cascades and rotating blade rows are presented and compared with test results.

N82-12079* # Draper (Charles Stark) Lab., Inc., Cambridge, Mass

RELIABILITY ANALYSIS OF THE F-8 DIGITAL FLY-BY-WIRE SYSTEM

L D Brock and H A Goodman Oct 1981 152 p refs (Contract NAS4-2571)

(NASA-CR-163110, R-1324) Avail NTIS HC A08/MF A01 CSCL 01C

The F-8 Digital Fly-by-Wire (DFBW) flight test program intended to provide the technology for advanced control systems, giving aircraft enhanced performance and operational capability is addressed. A detailed analysis of the experimental system was performed to estimated the probabilities of two significant safety critical events (1) loss of primary flight control function, causing reversion to the analog bypass system, and (2) loss of the aircraft due to failure of the electronic flight control system The analysis covers appraisal of risks due to random equipment failure, generic faults in esign of the system or its software, and induced failure due to external events. A unique diagrammatic technique was developed which details the combinatorial reliability equations for the entire system, promotes understanding of system failure characteristics, and identifies the most likely failure modes The technique provides a systematic method of applying basic probability equations and is augmented by a computer program written in a modular fashion that duplicates the structure of these equations

N82-12080*# Virginia Polytechnic Inst and State Univ. Blacksburg Dept of Aerospace and Ocean Engineering COMPUTATIONAL METHODS OF ROBUST CONTROLLER DESIGN FOR AERODYNAMIC FLUTTER SUPPRESSION Final Report, 14 Nov. 1980 - 15 Nov. 1981

Leonard R Anderson 15 Nov 1981 86 p refs Presented at the 3rd Intern Conf on Math Calif , 29-31 Jul 1981 Submitted for publication

(Grant NAG1-80)

(NASA-CR-164983, VPI-Aero-125) Avail NTI

HC A05/MF A01 CSCL 01C

The development of Riccati iteration, a tool for the design and analysis of linear control systems is examined. First, Riccati iteration is applied to the problem of pole placement and order reduction in two-time scale control systems. Order reduction, yielding a good approximation to the original system, is demonstrated using a 16th order linear model of a turbofan engine. Next, a numerical method for solving the Riccati equation is presented and demonstrated for a set of eighth order random examples. A literature review of robust controller design methods follows which includes a number of methods for reducing the trajectory and performance index sensitivity in linear regulators. Lastly, robust controller design for large parameter variations is discussed.

N82-12081# Tel-Aviv Univ (Israel) Dept of Electronic Systems

FÍXED GAIN CONTROLLER DESIGN FOR AIRCRAFT Final Scientific Report, 1 Jun. 1980 - 31 May 1981

Yoram Baram and Doran Eidelman 30 Jun 1981 31 p refs (Grant AF-AFOSR-0178-80. AF Proj 2301)

(AD-A104877, ESTTR-81-06, SCIENTIFIC-2, EOARD-TR-81-10) Avail NTIS HC A03/MF A01 CSCL

O1/3

A Method for designing fixed gain controllers and filters for systems with large parameter variation is presented. The approach based of minimax information criteria, is used to design a non-adaptive back-up control system for a given aircraft and is

shown to provide good performance qualities

N82-12082*# Computer Sciences Corp., Mountain View, Calif SIMULATOR CERTIFICATION METHODS AND THE VERTICAL MOTION SIMULATOR Final Report Thomas W Showalter 23 Sep 1981 67 p refs (Contract NAS2-9741)

(NASA-CR-166252) Avail NTIS HC A04/MF A01 CSCL 14B

The vertical motion simulator (VMS) is designed to simulate a variety of experimental helicopter and STOL/VTOL aircraft as well as other kinds of aircraft with special pitch and Z axis characteristics. The VMS includes a large motion base with extensive vertical and lateral travel capabilities, a computer generated image visual system, and a high speed CDC 7600 computer system, which performs aero model calculations. Guidelines on how to measure and evaluate VMS performance were developed. A survey of simulation users was conducted to ascertain they evaluated and certified simulators for use. The results are presented.

N82-12083# National Aerospace Lab , Tokyo (Japan) Aerodynamics Div

CONSTRUCTION AND PERFORMANCE OF NAL TWO-DIMENSIONAL TRANSONIC WIND TUNNEL

1980 104 p refs In JAPANESE, ENGLISH summary (NAL-TR-647, ISSN-0389-4010) Avail NTIS HC A06/MF A01

The construction and the results of initial calibration are described. This tunnel was built to meet the requirements of high Reynolds number testing of wing sections at transonic regime It is a blowdown tunnel with a test section of 0.3m x 1.0m The required capability of this wind tunnel is for Mach numbers ranging from 02 to 12 and for a Reynolds number up to 40 million at Mach number 08 with sufficient running time. An outline of the design objectives is given. The completed facilities, i.e., the wind tunnel, the instrumentation and operation system, the silencer and auxiliary equipment of the air compressor and the air reservoir, are described in detail. The performance of the tunnel when it is empty is described, and the results of a few experiments with an airfoil model of the NACA 64A410 are presented High Reynolds number testing can be achieved in this wind tunnel without any trouble B W

N82-12085*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va A LOOK INSIDE THE LANGLEY 16-FOOT TRANSONIC

A LOOK INSIDE THE LANGLEY 16-FOOT TRANSONIC TUNNEL. USER'S GUIDE

Kathryn H Peddrew, comp Aug 1981 197 p refs (NASA-TM-83186) Avail NTIS HC A09/MF A01 CSCL 14B

The 16-foot transonic tunnel is a single-return atmospheric wind tunnel having a slotted test section. The primary emphasis for research in this facility is the integration of the propulsion system into advanced aircraft concepts. The large test section size, 15.5 feet in diameter lends itself to conducting research in this area, where large models are required in order to provide adequate definition of the model geometry associated with the integration of the propulsion system. The nominal test Mach number range for this facility varies from 0.20 to 1.3. Topics covered include (1) facility description, (2) model installation equipment for aerodynamics, (3) model support system for propulsion simulation testing, (4) propulsion simulation systems, (5) calibrating propulsion simulation systems, (6) instrumentation, (7) data acquisition, (8) model design criteria, and (9) wind tunnel test planning.

N82-12142*# Boeing Commercial Airplane Co. Seattle, Wash IN-SERVICE INSPECTION METHODS FOR GRAPHITE-EPOXY STRUCTURES ON COMMERCIAL TRANSPORT AIRCRAFT Final Report

M L Phelps Nov 1981 105 p refs

(Contract NAS1-15304)

(NASA-CR-165746) Avail NTIS HC A06/MF A01 CSCL

In-service inspection methods for graphite-epoxy composite structures on commercial transport aircraft are determined Graphite/epoxy structures, service incurred defects, current inspection practices and concerns of the airline and manufacturers, and other related information were determined by survey. Based on this information, applicable inspection nondestructive inspection methods are evaluated and inspection techniques determined. Technology is developed primarily in eddy current inspection.

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N82-12143# McDonnell Aircraft Co , St Louis, Mo EFFECT OF FIGHTER ATTACK SPECTRUM ON COMPOSITE FATIGUE LIFE Final Report, Sep. 1978 - Oct. 1980 R Badaliance and H. D Dill Mar 1981 126 p refs

Author (GRA)

(Contract F33615-78-C-3218, AF Proj. 2401) (AD-A105034. AFWAL-TR-81-3001) Avail NTIS HC A07/MF A01 CSCL 11/4

The objective was to evaluate the effect of fighter wing load spectrum variations on the life behavior of composite structures. Six types of spectra were generated. (a) clipping to 90% test limit stress, (b) addition of stress overloads, (c) addition of low loads, (d) truncation to 70% test limit stress, (e) clipping of tension loads, (f) increased severity and number of air-to-air loads A single hole compression test specimen was designed to simulate fatigue critical areas of fighter wing skins

N82-12168*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif FIRE EXTINGUISHANT MATERIALS Patent Application Robert L Altman, Ludwig A Mayer (San Jose State Univ), and Alan C Ling, inventors (to NASA) (San Jose State Univ.) Filed 3 Nov. 1981 11 p (NASA-Case-ARC-11252-1, US-Patent-Appl-SN-317977) Avail NTIS HC A02/MF A01 CSCL 21B

Fire extinguishant materials were developed for extinguishing fires on hot metal surfaces caused by liquid fuels such as jet engine fuels. The composition of the materials is a mixture of a finely divided aluminum compound and alkali metal, stannous or plumbous halide. The aluminum compound may be aluminum hydroxide, alumina or boehmite, but preferably it is an alkali metal dawsonite. The metal halide may be an alkali metal, e.g. potassium iodide, bromide, or chloride, or stannous or plumbous iodide, bormide, or chloride. Potassium iodide is preferred. The presence of the halide improves the performance of the aluminum compound in extinguishing fires on hot metal

N82-12178# Atlantic Research Corp., Alexandria, Va. Combustion and Physical Science Dept

CHEMISTRY OF COMBUSTION OF FUEL-WATER MIX-TURES Final Technical Report, 1 Jun. 1980 - 31 May 1981

Edward G Skolnik, Edward T McHale, and Harley L Heaton Sep 1981 51 p refs (Contract N00014-80-C-0534)

(AD-A105401) Avail NTIS HC A04/MF A01 CSCL 21/2 The continuation of an experimental flame study concerning the nonphysical processes that lead to soot suppression when water is added to fuel, begun in a previous program is reported The study included a mapping of temperature, chemical species and soot profiles of laminar diffusion flames with and without water added Fuels studied included ethylene and a benzene/ hydrogen mixture. Flames with nonreactive gases added (argon. nitrogen), were also studied for comparison purposes. The study concludes that the reduction of soot by water in an ethylene diffusion flame can be completely explained by thermal effects The results are not as definitive for benzene. The addition of water causes a greater reduction in soot than does a thermally equivalent addition of argon, but no noticeable differences in chemical species profiles are observed. There is evidence, however, that water addition causes an increase in concentration of an oxygen-containing tarry substance present in the flame prior to soot formation. During the course of the study it was also possible to estimate both soot particle diameters (1-2 x 000001 cm at the beginning of the oxidation zone) and an activation energy for soot oxidation by the OH radical (7-8 kcal/mole) in addition. it was possible to confirm the presence of and quantify the oxygen concentration in the center of diffusion flames, first Author (GRA) reported under the previous program

N82-12216*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

PROGRESS IN PROTECTIVE COATINGS FOR AIRCRAFT GAS TURBINES A REVIEW OF NASA SPONSORED RESEARCH

John P Merutka 1981 29 p refs Presented at the 5th Ann Conf on Composite and Adv Mater, Merritt Island Fla 19-22 Jan 1981, sponsored by the Am Ceramic Soc, Inc (NASA-TM-82740, E-711) Avail NTIS HC A03/MF A01 CSCL 11F

Problems associated with protective coatings for advanced aircraft gas turbines are reviewed. Metallic coatings for preventing titanium fires in compressors are identified. Coatings for turbine section are also considered. Ductile aluminide coatings for protecting internal turbine-blade cooling passage surface are also identified Composite modified external overlay MCrAIY coatings

deposited by low-pressure plasma spraying are found to be better in surface protection capability than vapor deposited MCrAIY coatings Thermal barrier coating (TBC), studies are presented The design of a turbine airfoil is integrated with a TBC, and computer-aided manufacturing technology is applied

N82-12230* International Harvester Co., San Diego, Calif. FORMULATION AND CHARACTERIZATION OF POLYIMIDE RESILIENT FOAMS OF VARIOUS DENSITIES FOR AIR-CRAFT SEATING APPLICATIONS Final Report, 15 Feb. 1980 - 30 Sep. 1981 J Gagliani, R Lee, and U A. K. Sorathia 30 Sep 1981

151 p refs

(Contract NAS9-16009)

CSR81-R-4834-20) (NASA-CR-167421, NTIS HC AOB/MF AO1 CSCL 11G

Light weight, heat and fire resistant low smoke generating polyimide foams are developed for aircraft seating applications The material is upgraded and classified into groups for fabrication of cushions possessing acceptable comfort properties. Refinement and selection of foaming processes using a variety of previously developd foaming techniques and definition of property relationships to arrive at the selection and classfication of polyimide foams into five groups in accordance with predetermined ILD values are emphasized

N82-12248# Rensselaer Polytechnic Inst., Troy, N. Y. Dept of Mechanical Engineering.

DETERMINATION AND ANALYSIS OF JET AND MISSILE FUEL DEPOSITS Final Report

James L Lauer 14 Aug 1981 32 p (Contract N00164-79-M-2522)

(AD-A105458, NWSC/CR-RDTR-151) NTIS

HC A03/MF A01 CSCL 21/4

Jet fuel deposits, some of them supplied on their original support by Dr Hazlett of the Naval Research Laboratory, were examined by attenuated total reflection spectroscopy and by infrared Fourier transform emission spectroscopy for the purpose of finding a procedure suitable for in situ analysis. The infrared radiation emitted by samples at 50-65 C was adequate for qualitative analysis, which can readily be made quantitative by further work. Definite sharp peaks corresponding to aromatic materials were found Author (GRA)

N82-12255# Brookhaven National Lab , Upton, N Y

DEVELOPMENT OF CATALYTIC SYSTEMS FOR THE CONVERSION OF SYNGAS TO JET FUEL AND DIESEL FUEL AND HIGHER ALCOHOLS Annual Report

William A Slegeir Oct 1980 18 p (Contract DE-AC02-76CH-00016)

(DE82-000067, BNL-51423) Avail NTIS HC A02/MF A01

A highly active series of Fischer-Tropsch catalysts are developed on the basis of insights provided by the oxide theory. The method of catalyst formulation is unique in Fischer-Tropsch chemistry, yet is simple and reproducible. These catalysts are superior to ordinary catalysts for hydrocarbon synthesis with regard to rate, operating conditions, and, product selectivity and longevity. The products of these catalysts are ideally suited for use as diesel and jet fuels. Once formed, the catalysts display remarkable stability toward air. Oxide interactions, the role of promoters, and the synergistic behavior of bimetallic catalysts systems are studied Bimetallic systems for hydrocarbon and alcohol synthesis DOF are discussed

N82-12303# Federal Aviation Administration, Atlantic City, N J MOVING TARGET DETECTOR/AIRPORT SURVEILLANCE RADAR (ASR-7) FIELD EVALUATION Final Report, Feb. 1979 - Jan. 1980

W Goodchild Aug 1981 52 p refs

(AD-A105196, FAA-CT-81-31, FAA-RD-81-57) Avail NTIS HC A04/MF A01 CSCL 17/7

The Moving Target Detector (MTD) II, a sophisticated radar processor, was evaluated to determine its capability to provide improved radar detection in an air traffic control (ATC) environment. The MTD it was installed on one channel of an airport surveillance radar (ASR-7) at Burlington, Vermont The major objective of testing was to compare the performance of the MTD II with that of the ASR-7 Moving Target Indicator (MTI) This report concentrates on the comparative probability of detection, false alarm rate, MTI improvement factor, subclutter visibility, dynamic range, velocity response, and the simultaneous flight test results of the two systems. Comparison of the MTD II to the MTD I system is made when necessary to show major improvements or deficiencies in the MTD II design. The results of the tests have shown that the MTD II provides surveillance capabilities superior to those of the ASR-7/MTI Author (GRA)

N82-12304# Federal Aviation Administration, Atlantic City, NJ COLUMBUS, OHIO, VOICE RESPONSE SYSTEM DEMON-STRATION AND EVALUATION Final Report, Dec. 1979 -Apr 1980

John C Henline Jun 1981 54 p

(FAA Proj 131-402-854)

(AD-A104750, FAA-CT-80-50, FAA-RD-81-20) Avail NTIS HC A04/MF A01 CSCL 17/2

The Voice Response System (VRS) was subjected to a 4-month demonstration in the Columbus, Ohio, Flight Service Station (FSS) preflight area. The purpose of the experiment was to test and evaluate the VRS system, user acceptance, and the effects on the specialists/facility workload, and to determine the general impact of VRS on the Columbus (CMH) FSS preflight area In addition, the test permitted collection of technical performance data which could serve as the framework for an integrated national system for the mass dissemination of weather information. It is concluded that the VRS caused a shift in user demand/preference, reduced FSS briefer workload, reduced demand for basic pilots automatic telephone weather answering service (PATWAS), and was determined to be acceptable to the general aviation user Author (GRA)

N82-12392# ARO, Inc., Arnold Air Force Station, Tenn AN INVESTIGATION OF F-16 NOZZLE-AFTERBODY FORCES AT TRANSONIC MACH NUMBERS WITH EMPHA-SIS ON MODEL SCALE EFFECTS Final Report, Oct. 1979 - Sep. 1980

Earl A Price, Jr Sep 1981 149 p refs (AD-A104905, AEDC-TR-80-57, AFWAL-TR-81-2110) Avail NTIS HC A07/MF A01 CSCL 20/4

An experimental program was conducted to provide nozzleafterbody data with a minimum interference support system on a 0 25-scale F-16 model and to determine the interference induced on then nozzle-afterbody region by sting and strut model support systems Data obtained on the 0.25-scale model are compared with data from a 0.11-scale model for evaluation of model scale effects. The investigation was conducted over the Mach number range from 0.6 to 1.5. Data are presented in terms of coefficients and increments in coefficients of nozzle-afterbody axial and normal forces obtained from integrating pressure data. High-pressure air at ambient temperature was utilized for exhaust plume simulation. The results indicate close agreement in axial-force coefficient between configurations having full and annular nozzles at design pressure ratio. Very little effect of Reynolds number was found on the nozzle-afterbody axial force. Wave interference adversely affected axial-force data from the 0.25-scale model at Mach numbers between 1.0 and 1.1, producing lower axial force on the model afterbody. Large differences were determined in both the magnitude and the sign of strut interference from the two model installations

N82-12448# Naval Ocean Systems Center, San Diego, Calif PORTABLE AIR DRIVEN VARIABLE SPEED FIBER OPTIC CABLE TERMINATION POLISHER Technical Report, Mar. 1979 - Aug. 1980

A Flores 15 Mar 1981 46 p refs (AD-A104797, NOSC/TR-708) HC A03/MF A01 CSCL 13/8

Manufacturing processes and techniques were developed to produce in larger volume a portable air driven variable speed fiber optic cable polisher with the necessary characteristics to perform in the operational environments encountered during installation and maintenance of fiber optic cables in military aircraft Author (GRA)

N82-12648# Joint Publications Research Service, Arlington,

GERMAN-ARGENTINE EXPERIMENT: VERTICAL-ROTOR WIND ENGINE

Peter Raabe *In its* W Europe Rept Sci and Technol, No 72 (JPRS-78876) 1 Sep 1981 p 18-19 Transl into ENGLISH from Tagesspiegel (Berlin), 4 Jul 1981 p 12

Avail NTIS HC A03/MF A01

Designed by aerodynamists, a wind motor built in Patagonia, is independent of the direction of the wind due to its vertical rotating axis. The narrow rotor blades have optimum aerodynamic efficiency Drum-like wind collectors at the top and bottom of the rotating axis serve as starters. The plant incorporates simple instead of sophisticated mechanical parts, and its maintenance requirements are extremely low. Only the two rotating bearings located at the top and bottom of the axis require lubrication. with the oil being changed only twice a year

N82-13014# Systems Control, Inc., West Palm Beach, Fla Technology Industries Div

ANALYSIS OF INTEGRATED FUEL-EFFICIENT, LOW-NOISE PROCEDURES IN TERMINAL-AREA OPERATIONS

J B McKinley Jan 1981 125 p refs (Contract DE-AC01-80CS-50141)

(DE81-029833. DOE/CS-50141/T1) NTIS Avail HC A06/MF A01

The specific aviation energy conservation issues, terminal area fuel conservation and airport noise level relationships, are investigated. The potential fuel savings and noise level reduction in the Los Angeles International (LAX) terminal area between 1980 and 1990 attributable to compliance with the noise requirements of FAR Part 36 were quantified. These savings are due to the retiring, retrofiting and re-engining of older narrow-body aircraft (DC-8, B707, etc.) and the growth of wide body aircraft operations (DC-10, B747, B767, etc.) Current noise abatement procedures that could be relaxed without adversely impacting current (1980) noise levels, and at the same time conserving additional fuel. Two FAA computer models were used The Integrated Noise Model (INM) Version 27, was used for noise analysis and INKMOD, a preliminary fuel burn model, for the fuel analysis. The results of this detailed analysis revealed that due to the changing aircraft mix at LAX to include more wide body aircraft and fewer narrow body aircraft operations, airport noise level will decrease by 8 5 and 9 2 square miles on the 75 Ldn' contour for 1985 and 1990, respectively, from the 1980 baseline

N82-13043*# National Aeronautics and Space Administration Langley Research Center Hampton, Va

RESEARCH AND TECHNOLOGY Annual Report

Nov 1981 68 p (NASA-TM-83221) Avail NTIS HC A04/MF A01

Langley Research Center is engaged in the basic an applied research necessary for the advancement of aeronautics and space flight, generating advanced concepts for the accomplishment of related national goals, and provding research advice, technological support, and assistance to other NASA installations, other government agencies, and industry. Highlights of major accomplishments and applications are presented

N82-13048# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France)

THE IMPACT OF NEW GUIDANCE AND CONTROL SYSTEMS ON MILITARY AIRCRAFT COCKPIT DESIGN Aug 1981 217 p refs In ENGLISH, partly in FRENCH Symp

held in Bad-Cannstatt, West Germany, 5-8 May 1981 (AGARD-CP-312. ISBN-92-835-0297-3) HC A10/MF A01

The requirements and technologies involved in control systems were reviewed Topics incude, displays, controls/displays system integration, automated systems/man interface, and cockpit systems evaluation. Emphasis is placed on the design of a cockpit layout with controls and displays that maximize the overall aircraft capability while keeping the pilot's workload within bounds by the use of more automation of system management. For individual titles, see N82-13049 through N82-13064

N82-13049# Textron Bell Helicopter, Fort Worth, Tex Human Factors and Cockpit Arrangement Group

HOW THE HELICOPTER COCKPIT DESIGNER USES DIGITAL AVIONICS

John H Emery In AGARD The Impact of New Guidance and Control Systems on Mil Aircraft Cockpit Design Aug 1981 13 p ref

Avail NTIS HC A10/MF A01

An overview of the approaches to helicopter cockpit design made possible through the application of advanced multiplex technology to cockpit displays and controls is presented. This technology enables the pilot to have more information available while, at the same time, reducing his workload, and provides

for substantially improved cockpit management. One of the major research programs through which this technology was tailored for military helicopters is ADAS (Army Digital Avionics System). This program is discussed, along with Bell helicopter cockpit designs.

N82-13050# Smiths Industries Ltd , Bishops Cleeve (England) Aerospace and Defense Systems

ELECTRONIC FLIGHT DECK DISPLAYS FOR MILITARY TRANSPORT AIRCRAFT

R A Chorley In AGARD The Impact of New Guidance and Control Systems on Mil Aircraft Cockpit Design Aug 1981 12 p refs

Avail NTIS HC A10/MF A01

These display systems offer operational and economic advantages which can be realized in military as well as in civil aircraft. In particular, the flexibility of the display formats which can be provided, and the ease with which the information content can be changed, enable all the information required for the control of a transport aircraft to be displayed on the main panel, and go a long way towards making operation by a two-man crew possible. In addition, the flexibility of an electronic display system makes it feasible to minimize the effect of failures within the display system to an extent which is impossible in the case of conventional instruments. Full realization of this capability, which calls for careful selection of the system architecture to be employed, may lead to a significant in mission success. A discussion of CRT displays is presented.

N82-13051# Aeronautical Systems Div , Wright-Patterson AFB, Ohio Directorate of Avionics Engineering

COLOR CRT DISPLAYS FOR THE COCKPIT

Harry L Waruszewski In AGARD The Impact of New Guidance and Control Systems on Mil Aircraft Cockpit Design Aug 1981 22 p refs

Avail NTIS HC A10/MF A01

Color displays are currently being proposed for installation or are being installed in civilian and military aircraft cockpits. The complexity of designing a good color display is much greater than that of a monochromatic display. The human factors data and cockpit requirements needed to develop color cockpit displays so that requirements for a usable display can be generated are discussed. The color display technology was evaluated with respect to satisfying the established human factors requirements. Test methodologies need to be developed to determine compliance of the color displays to the specification requirement. Finally, the need for displays to be integrated into the cockpit using total cockpit human factors criteria to maximize the possible workload reduction and safety of the aircraft is discussed. T.M.

N82-13052# Thomson-CSF, Paris (France) HEAD UP DISPLAYS

Claude Maureau In AGARD The Impact of New Guidance and Control Systems on Mil Aircraft Cockpit Design Aug 1981 7 p

Avail NTIS HC A10/MF A01

The displays present information to pilots without depriving them of a simultaneous external view. This implies that head-up displays are collimated displays. The problems involved with collimation are discussed and the possibility of head-up providing pilots with directional information is considered.

N82-13053# Army Avionics Research and Development Activity, Fort Monmouth, N. J.

INTEGRATION OF CONTROLS AND DISPLAYS IN US ARMY HELICOPTER COCKPITS

J A Dasaro and C T Elliott In AGARD The Impacts of New Guidance and Control Systems on Mil Aircraft Cockpit Design Aug 1981 19 p refs

Avail NTIS HC A10/MF A01

Expanded missions such as anti-armor, night surveillance, and air-to-air, coupled with the survivability requirement of nap-of-the-Earth flight, dictate the approach to cockpit design. This approach must apply the latest technological innovations in the areas of controls, displays multiplexing, and microprocessors to unburden the pilot. Space, weight, and cost constraints placed on the cockpit system designers must also be satisfied. The U.S. Army completed a full scale engineering development program in the area of cockpit integration, and is currently involved in a more ambitious exploratory development effort. An overview

of these efforts to integrate the helicopter cockpit, including results of similation experiments and operational flight tests, is presented T M

N82-13054# Collins Radio Co , Cedar Rapids, Iowa Government Avionics Div

A STANDARD CONTROL DISPLAY UNIT FOR MULTI-AIRCRAFT APPLICATION

Ronald L Swanson and Craig R Scougton In AGARD The Impact of New Guidance and Control Systems on Mil Aircraft Cockpit Design Aug 1981 10 p

Avail NTIS HC A10/MF A01

The need for standardization of military hardware is well documented both within the US DOD and NATO Standardization issues revolve mainly around interoperability, logistics, and life-cycle cost advantages. The issue of standardization and its suitability in the design of aircraft control/display units (CDU) is addressed. Potential benefits, requirements, and remaining problems associated with standardization of avionics control displays are discussed. Included is a discussion of a CDU that is currently being produced which has many of the features considered essential to the ultimate standard CDU.

N82-13056# Crouzet Aerospace and Systems, Valence (France) USING VOICE CONTROL ONBOARD COMBAT AIRCRAFT [UTILISATION DE LA COMMANDE VOCALE A BORD DES AERONEFS DE COMBAT]

J R Coster and J M Melocco In AGARD The Impact of New Guidance and Control Systems on Mil Aircraft Cockpits Design Aug 1981 5 p In FRENCH

Avail NTIS HC A10/MF A01

The use of the voice would be a valuable tool in resolving problems associated with pilot workload, in reducing the surface of the flight instrument system and the complexity of the man machine interface in high performance combat aircraft. A program established at the Laboratory of information for Mechanics and Engineering Sciences validates in aircraft environments the methods of speech recognition and synthesis developed in research laboratories. It is merely a matter of the universal recognition, at the acoustic level of isolated words pronounced by a single speaker. The techniques used are described. These include laboratory experiments involving an aeronautical dialog in a noisy environment and experimentation with a simulator of a vocal dialog applied to an aircraft with modern weapons and to the study of human factors Experimentation also takes place in a flight simulator Transl by ARH

N82-13060# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany) Inst fuer Flugfuehrung

EXPERIMENTAL INVESTIGATION OF A HELMET MOUNTED SIGHT/DISPLAY FOR HELICOPTER

R Beyer, E Danneberg, E Kohnen, and H Stein *In* AGARD The Impact of New Guidance and Control Systems on Mil Aircraft Cockpit Design Aug 1981 11 p

Avail NTIS HC A10/MF A01

A helmet mounted sight/display (HMS/D) combined with an infrared camera and electronic instrument displays was investigated as a guidance aid for the low level flight of helicopters at night. The static and dynamic accuracy of the tracking mechanism which aligns the lines of sight of both the pilot and the camera was determined by means of a target and motion simulator. System performance was checked with a Bo 105 helicopter in low level flight at night. From the results obtained the importance of the HMS/D as an guidance aid becomes evident relative to other night vision/display systems.

N82-13061# Royal Aircraft Establishment, Farnborough (England) Flight Systems Dept

USE OF A HELMET-MOUNTED MATRIX DISPLAY FOR PRESENTING ENERGY-MANEUVERABILITY INFORMATION DURING SIMULATED CLOSE COMBAT

D N Jarrett In AGARD The Impact of New Guidance and Control Systems on Mil Aircraft Cockpit Design Aug 1981 10 p refs

Avail NTIS HC A10/MF A01

Since continuous visual contact display (HMMD) with the

enemy is essential in close combat the provision of this information on a helmet-mounted diplay (HMMD) may be particularly useful However, the (in) visibility of the image against a bright sky background, the increased helmet weight and other inconveniencing counter effects when coupled with the high attentional and physical demands of combat, may obviate any advantages of controlling the aircraft using the extra information. A series of exercises was set up to assess the HMMD in this application. The device was the subject of a flight trial in a light jet aircraft, and two studies were completed in the newly-commissioned RAE air combat simulator. These studies enabled pilots to become familiar with the device and the unusual display format, in order to assess their combined usefulness in a combat context.

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ARH

N82-13063# Air Force Wright Aeronautical Labs , Wright-Patterson AFB, Ohio

TANKER AVIONICS AND AIRCREW COMPLEMENT EVALUATION

Richard W Moss and Gregory J Barbato (Bunker-Ramo Corp., Dayton, Ohio) In AGARD The Impact of New Guidance and Control Systems on Mil Aircraft Cockpit Design Aug 1981 18 p refs

Avail NTIS HC A10/MF A01

A four phase effort addressing the control and display design issues associated with operating the SAC'S KC-135 tanker without the navigator crew position is discussed. Topics covered include the mission analysis phase during which the tanker's operational responsibilities were defined and documented, the design phase during which alternative crew station design concepts were developed, the mockup evaluation phase which accomplished initial SAC crewmember assessment of cockpit designs, and the simulation phase which validated the usability of the crew system redesign. A recommended crew station configuration is examined and some of the philosophy underlying the selection of cockpit hardware and systems is discussed.

N82-13064# McDonnell Aircraft Co , St Louis, Mo F/A 18 HORNET CREW STATION

Eugene C Adam In AGARD The Impact of New Guidance and Control Systems on Mil Aircraft Cockpit Design Aug 1981 6 p

Avail NTIS HC A10/MF A01

The Homet crew station design requirement was to essentially provide the capability contained in both the F-4 and A-7 weapon systems so as to perform both the fighter attack roles, make it operable by one pilot, and increase mission reliability by a combination of improved hardware reliability and functional redundancy. To put this requirement in perspective, the F/A-18 cockpit has 40% less usable area than any of its contemporaries. This area constraint necessitated extensive integration of the weapon system controls and displays. The resultant crew station features four militipurpose cathoderay displays driven by two mission computers, an integrated upfront control panel, and numerous automatic functions on the stick and throttle. The rationale leading up to the configuration is described and a few examples of the one-man-operability features of the Hornet and how they would used by the pilot are presented.

N82-13065# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France)

AERODYNAMICS OF POWER PLANT INSTALLATION

Sep 1981 510 p refs In ENGLISH and FRENCH Proc of conf held in Toulouse, 11-14 May 1981 (AGARD-CP-301, ISBN-92-835-0301-5) Avail NTIS HC A22/MF A01

The aerodynamic problems in power plant installation are surveyed and computational and design methodologies are presented Combat aircraft intakes, afterbodies and nozzles, testing and analysis techniques, and installation aerodynamics of transport aircraft are addressed For individual titles, see N82-13066 through N82-13098

N82-13066# Air Force Wright Aeronautical Labs, Wright-Patterson AFB, Ohio

PERFORMANCE OF HIGHLY INTEGRATED INLETS FOR SUPERSONIC AIRCRAFT

Lewis Surber, Jan Syberg, and Joseph Koncsek In AGARD Aerodyn of Power Plant Installation Sep 1981 12 p refs Prepared in cooperation with Boeing Military Airplane Co., Seattle Avail NTIS HC A22/MF A01

Performance data obtained on several subsonic diffusers applicable to advanced supersonic tactical aircraft configurations were used to select a forebody-inlet model for proof-of-concept wind tunnel performance evaluation. Three of the diffusers were designed for high aspect ratio inlets having throat aspect ratios greater than seven. A fourth design incorporated a low aspect ratio inlet. Two of the high aspect ratio diffusers and the low aspect ratio diffuser incorporated duct bends typical of inlets substantially offset from the engine centerline. Preliminary tests of the high aspect of ratio diffuser produced high total pressure recovery coupled with relatively low flow distortion. Furthermore, the use of longitudinal vanes in one high aspect ratio diffuser provided reductions in engine face flow distortion with very little performance degradation Proof-of-concept tests further investigated the performance of a high aspect ratio, side-mounted external compression supersonic inlet. Tests were performed in a 16-foot supersonic propulsion wind tunnel at Mach numbers of 16 to 22 over a -5 to 12 deg angle of attack range and sideslip angles from -8 to +8 deg. The results of these tests support the use of high aspect ratio inlets with sharp duct bends as a viable design option in future supersonic aircraft designs

N82-13068# Royal Aircraft Establishment, Bedford (England) Aerodynamics Dept

SOME RAE RESEARCH ON SHIELDED AND UNSHIELDED FUSELAGE MOUNTED AIR INTAKES AT SUBSONIC AND SUPERSONIC SPEEDS

J A Ross, I McGregor, and A J Priest In AGARD Aerodyn of Power Plant Installation Sep 1981 16 p refs
Avail NTIS HC A22/MF A01

The incidence performance of fuselage-mounted intakes at subsonic and supersonic speeds is examined. The effects of simple changes in intake geometry, such as increasing contraction ratio and altering lower lip shape, are first considered, it is shown that such modifications can be beneficial at subsonic speeds, but drag penalties tend to limit their use at higher Mach numbers Two intake locations that potentially offer a good degree of incidence shielding - underfuselage and understrake - are then examined it is concluded that satisfactory performance can be obtained with an understrake installation, but a detailed study of strake shape, slots, splitter plates and boundary layer diverters must be made if the combinaion is to be successful over the whole of the intended flight envelope. However, for the configurations tested, the underfuselage location offers generally better intake performance lower technical risk. Finally, some results for a side-mounted staggered lip intake are presented, together with some two dimensional calculations of the mutual interference effects that occur between the upper and lower lips. It is suggested that an intake of this type can be competitive with an underfuselage installation

N82-13069# National Gas Turbine Establishment, Pyestock (England)

PREDICTION AND MEASUREMENT OF TIME-VARIANT, THREE-DIMENSIONAL FLOWS IN MILITARY AIRCRAFT INTAKES

D E Colbourne and J E Flitcroft *In* AGARD Aerodyn of Power Plant Installation Sep 1981 18 p refs
Avail NTIS HC A22/MF A01

The development of a computational method suitable for predicting the three dimensional flows within the diffuser sections of aircraft intakes is described. A fast method for automatic grid generation, application to ducts of any smoothly varying cross-sectional shape, is discussed. The development of a finite-volume, time-marching method for solving the flow equations is also described. The validity of the chosen techniques is discussed in the light of comparisons with analytical and empirical results Empirical techniques were developed to examine flows in which viscous or time variant effects are dominant. A rotating yaw meter rake was developed to undertake detailed flow surveys at the exit of model diffusers, and results may be obtained from tests both in isolation and in the presence of a compressor. The development of instrumentation and data processing facilities for measuring instantaneous engine face total pressure distortion in small scale models is also described, together with the validation of this technique by comparison with results from a full-size replica of the intake tested under free-jet conditions

N82-13070# British Aerospace Aircraft Group, Bristol (England)
EFFECTS OF INTAKE GEOMETRY ON CIRCULAR PITOT

INTAKE PERFORMANCE AT ZERO AND LOW FORWARD SPEEDS

A C Willmer, T W Brown, and E L Goldsmith (RAE, Bedford, England) In AGARD Aerodyn of Power Plant Installation Sep 1981 16 p refs Sponsored in part by Ministry of Defence Avail NTIS HC A22/MF A01

A series of experiments on circular cross-section pitot intakes at Mach numbers from 0 to 021 and angles of incidence and sideslip from 0 to 40 deg are presented. Measurements were made at the engine face of 72 pitot pressures 4 unsteady pitot pressures, swirl angle at six positions, and boundary layer profiles at four positions. Static pressure distribution around the cowl lips and along the diffusers were also measured. Five cowl lips covering a range of contraction ratios and lip shapes were tested with both a straight and an S bend diffuser. The effect of inserting parallel section spacers between the cowl lip and the front of the subsonic diffuser and between the end of the subsonic diffuser and the engine face instrumentation and the effect of a thin lip slot upstream of the intake throat were evaluated. Results indicate that, lip losses may be decreased by increasing contraction ratio, fitting a lip slot or a forward spacer. Steady state flow distortion at the engine face is decreased by increasing lip contraction ratio or by fitting an aft extension. For the S duct tested, distortion levels are set by the diffuser as much as by incidence. Sideslip however lessens the distortions

N82-13071# Institut de Mecanique des Fluides de Lille (France)
TRANSONIC FLOWS IN AN AIR INLET WITH LARGE
INCIDENCE AND THE EFFECT OF A BLOWING TRAP
[ECOULEMENTS TRANSSONIQUES DANS UNE PRISE
D'AIR EN GRANDE INCIDENCE AT EFFET DE TRAPPE
DE SOUFFLAGE]

A Dyment, P Gryson, and J P Flodrops In AGARD Aerodyn of Power Plant Installation Sep 1981 13 p ref In FRENCH

Avail NTIS HC A22/MF A01

Flow in a bidimensional air intake with large incidence was studied under conditions in which the upstream flow was subsonic and the internal flow could be regulated. The phenomena following flow separation were examined, especially the homogenization of the internal flow. A device for improving mogenization which involves a natural deflection accomplished by a scoop designed to guide the captivated air was tested. The universal aspect of internal flow was studied using probes in different sections. The unsteady phenomena were analyzed from ultra high speed visualizations and the mean flow was characterized from classic visualization. The insertion of the deflector appreciably improved the performance of the air intake. The coefficient of output (sigma) and the total mean pressure (P sub tm) were considerably improved at the level of the compressor. While the use of the scoop to guide the air towards the slot had only a weak influence on sigma and P sub tm at the compressor level, it brought an appreciable gain in the speed of homogenization of the internal Transl by ARH

N82-13073# Aeritalia S.p.A. Torino (Italy) Combat Aircraft Group

SUBSONIC MILITARY AIRCRAFT ENGINE INTAKE AN INTEGRATED THEORETICAL EXPERIMENT DESIGN

G Bertolone and L Fornasier In AGARD Aerodyn of Power Plant Installation Sep 1981 17 p refs

Avail NTIS HC A22/MF A01

Two numerical codes were developed for the simulation of the engine intake-induced flow field in two dimensional transonic and three dimensional subsonic cases. Both codes were obtained by modification of existing codes suitable for the computation of the exterior flow past airfoils (by a finite element method) and about three dimensional arbitrary configurations (by a panel method) Computed results and comparison with experimental data pertinent to the analysis of a single bifurcated intake proved usefulness of the present numerical schemes for engineering applications. Engine face auxiliary doors design and side intakes diverter shape optimization was studied. Following an extensive testing program performed on a static model the engine face auxiliary doors with annular air admission into the primary long type duct appeared to be a good alternative to the classical solution placed at the main inlet entry. Diverter geometry influence both on aerodynamics in terms of drag coefficient, and intake performance, in terms of distortion coefficient was investigated by testing a low speed model

N82-13074# Messerschmitt-Boelkow-Blohm G m b H , Munich (West Germany) Unternehmensbereich flugzeuge THE DESIGN AND DEVELOPMENT OF THE TORNADO ENGINE AIR INTAKE

C P Stocks (British Aerospace, Warton, England) and N C Bissinger In AGARD Aerodyn of Power Plant Installation Sep 1981 21 p refs

Avail NTIS HC A22/MF A01

The design and development of the Tornado aircraft supersonic intake is described. Critical aerodynamic design areas are outlined with special emphasis on compatibility. The intakes were designed to satisfy the conflicting requirements of greater than Mach 2 operation and a very wide incidence operating envelope at subsonic speeds. The problem of design loads is reviewed as well as the theory and operation of the automatic control system. Propulsion system behavior in flight and some examples of intake-airframe interaction are described.

N82-13075# Air Force Wright Aeronautical Labs , Wright-Patterson AFB, Ohio

INTEGRATION OF ADVANCED EXHAUST NOZZLES

Douglas L Bowers and James A Laughrey In AGARD Aerodyn of Power Plant Installation Sep 1981 14 p refs

Avail NTIS HC A22/MF A01

Attributes of both axisymmetric and nonaxisymmetric advanced nozzles and their incorporation into an aircraft to improve cruise performance, maneuverability and short takeoff and landing operation are discussed. It was concluded that when used as a trimming device, advanced exhaust nozzles with thrust vectoring can provide significant aircraft cruise drag reduction. The aftbody/nozzle installation for advanced airframes and exhaust nozzles must be approached very carefully to demonstrate an installed drag benefit. For maneuver, advanced thrust vectoring exhaust nozzles show advantages at high angle of attack. Improved turn rate and instantaneous maneuver performance can be provided by utilizing these advanced exhaust nozzles in advanced aircraft. For short takeoff and landing aircraft advanced exhaust nozzles with both thrust vectoring and thrust reversing may be necessary. Thrust vectoring up to 60 degrees (or higher) and a propulsive lift control system may be required

N82-13076# Rolls-Royce Ltd , Bristol (England) Installation Aerodynamics Group

THE SUBSONIC PERFORMANCE OF PRACTICAL MILITARY VARIABLE AREA CONVERGENT NOZZLES

L R Harper IN AGARD Aerodyn of Power Plant Installation Sep 1981 11 p refs

Avail NTIS HC A22/MF A01

Performance considerations involved in the selection of a variable area nozzle for reheated engines for combat aircraft are discussed. The main emphasis is on dry operation at subsonic speeds since drag, weight, leakage and other penalties in this regime can prevent an aircraft attaining its design radius of action. Zero-base nozzles are compared with a moving shroud nozzle which has a substantial annular base area in dry setting. The moving shroud nozzle, as used on the RB199 engine in the Tornado MRCA, is very competitive with zero base nozzles in terms of overall performance. It is light, mechanically simple, reliable, and its short length permits a target type thrust reverser to be used. It is concluded that this type of nozzle is the optimum choice for combat aircraft until further technology advances permit substantial improvements in the overall performace of the more sophisticated nozzles.

N82-13077# Motoren- und Turbinen-Union Muenchen G m b H (West Germany)

COMPARISON OF DIFFERENT NOZZLE CONCEPTS FOR A REHEATED TURBOFAN

H Grieb R Vedova H Enderle, and H Nagel In AGARD Aerodyn of Power Plant Installation Sep 1981 15 p refs Sponsored in part by German Ministry of Defence

Avail NTIS HC A22/MF A01

Several concepts of convergent and convergent/divergent nozzles are investigated and compared in view of performance, weight, complexity and the influence on afterbody drag of combat aircraft. The influence of different nozzle cooling concepts on thrust, with subsequent cooling air requirements, is investigated. The optimum ratio of exit area/throat area of convergent/divergent nozzles dependent on nozzle concept and nozzle pressure ratio.

is identified. The performance comparison shows that fully variable convergent/divergent nozzles promise some advantages against the simple convergent nozzle at high nozzle pressure ratios. However, the higher weight and complexity of convergent/divergent nozzles lead to the conclusion that the choice of convergent/divergent nozzles for reheated turbofan engines in combat aircraft is not generally justified.

N82-13078# Air Force Wright Aeronautical Labs , Wright-Patterson AFB, Ohio Aero Propulsion Lab

ADVANCED EXHAUST NOZZLE TECHNOLOGY

Ronald J Glidewell and Robert E Warburton (Pratt and Whitney Aircraft Group, West Palm Beach, Fla.) In AGARD Aerodyn of Power Plant Installation Sep. 1981 11 p. refs

Avail NTIS HC A22/MF A01

Turbine engine exhaust nozzle technology including nonaxisymmetric nozzles, thrust reversing, and thrust vectoring was investigated. Trade studies to determine the impact of these developments on the thrust-to-weight ratio and specific fuel consumption of an advanced high performance, augmented turbofan engine are reported. Results are presented in a manner which provides a understanding of the sources and magnitudes of differences in the basic elements of nozzle internal performance and weight as they relate to conventional axisymmetric nozzle technology. These comparisons are presented for three categories of nozzle functional capability, jet area and exit area control, thrust reversing, and thrust vectoring.

N82-13082# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France)

AN ACQUISITION AND ANALYSIS SYSTEM FOR DYNAMIC TESTS OF AIR INLETS [SYSTEME D'ACQUISITION ET D'ANALYSE POUR ESSAIS DYNAMIQUES D'ENTREES D'AIR]

Pierre Perrier, Bertrand Delahaye (SNWCMA, Moissy Cramayel France) and Gerard Laruelle (ONERA Chatillon France) In AGARD Aerodyn of Power Plant Installation Aug 1981 14 p refs In FRENCH

Avail NTIS HC A22/MF A01

Improving the flight domain of combat aircraft leads to operations involving a much large variation of unsteady aerodynamic characteristics at the engine inlet than in the past. To determine if the augmentation will be effectively acceptable for compressors and engines of the future, sufficient knowledge of flows must be acquired. This entails measuring a sufficient number of unsteady flow characteristics, however, the number of measurements made must be limited because of cost as well as because of the possibility of instantaneous or deferred processing. This sequence of measurements takes into account necessary compromises Cooperation is needed among the aircraft designer the engine designer, and the research organization so that the work of each can complement that of the others, and an economy of means and a homogeneity of methods for analyzing and interpreting the results is possible Transl by ARH

N82-13084# Fluidyne Engineering Corp., Minneapolis, Minn MODEL TESTING TECHNIQUES FOR MEASURING INLET DRAG

James S Holdhusen and James L Grunnet In AGARD Aerodyn of Power Plant Installation Sep 1981 8 p refs Avail NTIS HC A22/MF A01

Two methods of measuring inlet drag in transonic flow are described. In the first method, a flow through nacelle is tested in a transonic wind tunnel. Capture ratio is varied by installing individual annular blockers in the nacelle. Corrections for the drag force exerted by the captured streamtube are determined from blow through tests in a static test stand. In the second method, drag is determined directly using a special rig which has a variable loss throttle. The thrust exiting the control surface is determined by a choked ASME nozzle. The advantages and disadvantages of the two methods are compared.

N82-13085# National Defence Headquarters, Ottawa (Ontario) Directorate of Science and Technology

COMPRESSOR STALL INDUCING INSTALLATION EFFECTS OF AN ENGINE CONTROL PARAMETER FOR THE CF-5 AIRCRAFT

W L Macmillan, D M Rudnitski, and W Grabe In AGARD Aerodyn of Power Plant Installation Sep 1981 17 p Prepared in cooperation with National Research Council of Canada Ottawa

Avail NTIS HC A22/MF A01

Compressor stall problems with CF-5 aircraft powered by two J85-CAN-15 engines were investigated. One major cause for compressor stalls as improper operation of the engines control system under low temperature conditions was identified. It is demonstrated that this control system malfunction is the result of engine installation effects which produce an erroneous compressor inlet temperature signal to the main fuel control unit. The degree of signal error for several flight conditions such as level flight, high angles of attack, aircraft stalls, and weapons delivery profiles are identified. It is found that temperature errors are greater at high angles of attack where severe compressor inlet distortion acts cumulatively in reducing the stall margin under this flight condition.

N82-13086# Vereinigte Flugtechnische Werke G m b H Bremen (West Germany)

THE ROLE AND IMPLEMENTATION OF DIFFERENT NACELLE/ENGINE SIMULATION CONCEPTS FOR WIND-TUNNEL TESTING IN RESEARCH AND DEVELOPMENT WORK ON TRANSPORT AIRCRAFT

B Ewald and R Smyth In AGARD Aerodyn of Power Plant Installation Sep 1981 35 p refs

Avail NTIS HC A22/MF A01

Different experimental methods and their specific roles in various stages of research and development were investigated. The main problem is the simulation and calibration of the propulsion system. Different simulation methods are flow through nacelles, powered nacelles (blowing, turbine powered simulators (TPS), ejector powered), inlet models. The TPS represent the most advanced simulation of the high bypass ratio engine in model scale. A large part of the wind tunnel tests still have to rely upon flow through nacelles. A novel flow through nacelle with a variable plug is presented. It is shown that the combination of flow through nacelles and TPS can be efficiently used in the windtunnel investigation of propulsion system effects for transport aircraft.

N82-13087# Office National d'Etudes et de Recherches Aerospatiales, Paris (France)

WIND TUNNEL TESTS OF POWERED MODELS A COMPARISON OF TWO METHODS OF SIMULATING THE JETS OF JET ENGINES [ESSAIS EN SOUFFLERIE DE MAQUETTES MOTORISEES, COMPARAISON DE DEUX METHODES DE SIMULATION DES JETS DES REACTEURS]

J P Becle and R Perin (SNIAS Toulouse) In AGARD Aerodyn of Power Plant Installation Sep 1981 18 p ref In FRENCH

Avail NTIS HC A22/MF A01

Two methods for simulating engine jets were developed at ONERA. The so-called blowing jets were previously mounted for studying the Concorde. The second method which uses small air breathing turbines was recently installed for Airbus family aircraft. Tests were conducted on semi-models mounted on a balance with six components traversed by the flow from the engine. An original mounting permits the same measurement means to be used for any principle of power or type of test used (fixed point or wind tunnel test). The installations means of measurement, and methods of using the results are described. The respective advantages of each type of power simulation are considered from the viewpoints of complexity duration and precision of measurements obtained.

N82-13088# Aircraft Research Association Ltd Bedford (England)

WIND TUNNEL TEST AND ANALYSIS TECHNIQUES USING POWERED SIMULATORS FOR CIVIL NACELLE INSTALLATION DRAG ASSESSMENT

A E Harris and E C Carter In AGARD Aerodyn of Power Plant Installation Sep 1981 16 p refs

Avail NTIS HC A22/MF A01

Full span and semi-span wind tunnel model tests and powered nacelle calibration techniques are discussed in the context of civil nacelle installation drag assessment and optimization. In order to achieve the accuracy required for drag analysis it is necessary to determine the installed net thrust of the powered nacelle simulator to the equivalent of at least one aircraft drag count. This implies stringent control of mass flow and thrust

accounting and imposes the need for consistency of approach in the wind-on and calibration tests where thrust and mass flow coefficients must be known to 0.1% to 0.2% accuracy. This need for high confidence in the data at all stages of analysis led to a methodology in which the measured data is combined in various ways to enhance confidence in its final use. Experiences obtained in the use of a Mach simulation tank (MST) for the calibration of turbine powered simulator units are discussed. The MST is used to obtain simultaneous mass flow and thrust calibrations with representative internal nacelle conditions in the presence of a quiescent exhaust environment. Practical problems associated with the design of balance and airfeed airangements are discussed along with the use of blown and turbine powered simulators.

N82-13089# Rolls-Royce Ltd, Derby (England)
ESTABLISHMENT OF AN EXPERIMENTAL TECHNIQUE TO
PROVIDE ACCURATE MEASUREMENT OF THE INSTALLED
DRAG OF CLOSE COUPLED CIVIL NACELLE/AIRFRAME
CONFIGURATIONS, USING A FULL SPAN MODEL WITH
TURBINE POWERED ENGINE SIMULATORS

G Pugh and A E Harris (Aircraft Research Association Ltd., Bedford, England) In AGARD Aerodyn of Power Plant Installation Sep 1981 9 p refs

Avail NTIS HC A22/MF A01

Definition and optimization of installed thrust/drag in civil nacelle installation design and development was studied. As a means of validating the calibration and thrust/drag analysis techniques bodied transport, Lockheed L1011, having high bypass ratio RB 211 turbofan engines with two alternative exhaust system designs was used. Wind tunnel model representation comprised a full span simulation with underwing mounted turbine powered engine simulation. Calibration techniques included the use of a Mach simulation tank in which concurrent mass flow and thrust calibrations were conducted in a quiescent exhaust environment. Data presented includes nacelle thrust and discharge coefficients, installed drag comparisons, and, finally, model to flight correlations.

N82-13090# National Aerospace Lab , Amsterdam (Netherlands) EVALUATION OF AN EXPERIMENTAL TECHNIQUE TO INVESTIGATE THE EFFECTS OF THE ENGINE POSITION ON ENGINE/PYLON/WING INTERFERENCE

J A J vanEngelen, B Munniksma, and A Elsenaar In AGARD Aerodyn of Power Plant Installation Sep 1981 13 p refs

Avail NTIS HC A22/MF A01

A flexible experimental technique to study the effect of a variation of engine position for a range of test conditions was evaluated in this test an underwing mounted 3/4 fancowl engine was investigated at six different positions as a free flow nacelle and as a strut mounted blown nacelle Pressure and balance force measurements were made. Some typical aspects of the aerodynamic interference are discussed, notably the value of free flow nacelle measurements. Also a comparison of balance weighed and integrated pressure forces is presented. Results indicate that accurate simulation of the engine nozzle geometry is of prime importance for an investigation concerning engine/airframe integration. Nevertheless, tests on a free flow nacelle may still be useful for the selection of the most favourable engine position A reasonable correlation was established between interference forces as obtained from pressure integration and balance measurements. However, the pressure forces tend to underestimate the balance forces. For a flexible pathfinder test, interference forces derived from pressure integration only appear to be very useful for the determination of trends in interference effects

вw

N82-13091# Office National d'Etudes et de Recherches Aerospatiales, Paris (France)

STUDIES OF AIR INLETS AT REYNOLDS NUMBERS COMPARABLE TO FLIGHT IN ONERA'S F1 AND S1MA WIND TUNNELS [ESSAIS DE PRISES D'AIR A DES NOMBRES DE REYNOLDS COMPARABLES AU VOL DANS LES SOUFFLERIES F1 ET S1MA DE L'ONERA]

J Leynaert In AGARD Aerodyn of Power Plant Installation Sep 1981 12 p refs in FRENCH

Avail NTIS HC AZ2/MF A01

The pressurization of the subsonic F1 wind tunnel at ONERA's

Fauga-Mauzac Center was a benefit in wind tunnel tests of the air intakes of Airbus-type aircraft on a large scale at a Reynolds number near that of flight. The same model can thus be tested up to a Mach number near 1 in the S1MA wind tunnel at the Modane Center. Air intakes of military aircraft can likewise be studied in the two wind tunnels at high Reynolds numbers. The apparatus used the methods of measurement, and the means of calibrating and control used to assure valid results are presented.

N82-13092# British Aerospace Aircraft Group, Hertfordshire (England) Research Dept

THE INFLUENCE OF CLOSED-COUPLED, REAR FUSELAGE MOUNTED NACELLES ON THE DESIGN OF AN ADVANCED HIGH SPEED WING

R D Laugher In AGARD Aerodyn of Power Plant Installation Sep 1981 17 p refs

Avail NTIS HC A22/MF A01

The design approach aimed at integrating the effect of the nacelle into the basic wing design is described. Particular attention is drawn to the design risk associated with the modified inner wing supercritical flow development when nacelles are not represented in the transonic design calculations Experimental test results are described which demonstrate the general success of the design technique. Finally, some results are presented from theoretical investigations in which an attempt was made to simulate the interference effect of the nacelle on the wing supercritical flowfield. A technique was developed whereby the nacelle and intake streamtube are replaced by an equivalent interfering body, which is derived from subcritical flow interference pressures Results show that this technique provides a simple, cost effective tool for the supercritical design of a wing operating in the influence of a rear nacelle MDK

N82-13093# Royal Netherlands Aircraft Factories Fokker. Schiphol-Oost Aerodynamics Dept
AERODYNAMIC ASPECTS OF A HIGH BYPASS PATIO

AERODYNAMIC ASPECTS OF A HIGH BYPASS RATIO ENGINE INSTALLATION ON A FUSELAGE AFTERBODY

N Voogt, J vanHengst, and J Th v d Kolk (NRL) In AGARD Aerodyn of Power Plant Installation Sep 1981 10 p refs

Avail NTIS HC A22/MF A01

The design process used in shaping rear fuselage mounted large diameter engine nacelles, pylons, and fuselage for a transport type aircraft is described. The objective was to suppress the local velocity levels and pressure gradients to avoid aerodynamic interference drag of the nacelle-pylon-fuselage combination in high speed cruise flight. Shapes of fuselage afterbody, nacelle, and stubwing were modified in a design-by-analysis process involving iterative and three dimensional singularity methods for inviscid subsonic flow. Windtunnel tests confirmed the adequacy of these methods.

M.D.K.

N82-13094# Societe Nationale Industrielle Aerospatiale.
Toulouse (France) Service Aerodynamique Theorique
A NUMERICAL METHOD FOR STUDYING NACELLE-JETAIRFOIL INTERACTION IN INVISCID THREEDIMENSIONAL FLOW (UNE METHODE NUMERIQUE POUR
L'ETUDE DE L'INTERACTION NACELLE-JET-VOILURE EN
ECOULEMENT TRIDIMENSIONEL NON VISQUEUX)

G LeGall, J Bousquet, and M Yermia In AGARD Aerodyn of Power Plant Installation Sep 1981 13 p refs in FRENCH

Avail NTIS HC A22/MF A01

The nacelle-jet-airfoil interaction is a complex three dimensional phenomena which is addressed in two simplified hypotheses the fluid is incompressible and inviscid. Under these two hypotheses the propulsive configuration is modeled by air intake with flow control and a propulsive jet with control of the pressure generator. A method of singularities is used which considers the sources and doublets of constant density and doublets of linear density on a flat panel. The equations which govern the problem constitute a nonlinear system which is divided into a linear part and a quadratic part. These two parts are solved iteratively by the Gauss-Seidel method and the Newton method. The free boundaries of the flow are also calculated by an iterative process which is integrated into the two preceding methods.

flow Comparison with tests permits evaluation of the advantage of the 'simplified hypotheses Transl by ARH

N82-13095# Vereinigte Flugtechnische Werke G m b H , Bremen (West Germany)

CALCULATION OF WING-BODY-NACELLE INTERFERENCE IN SUBSONIC AND TRANSONIC POTENTIAL FLOW

K D Klevenhusen H Jakob, and H Struck In AGARD Aerodyn in Power Plant Installation Sep 1981 8 p refs

Avail NTIS HC A22/MF A01

A calculation method especially for transport aircraft wing design with consideration of wing/body or engine/airframe interference was developed A hybrid method, consisting of a combination of panel method and finite difference method is an improvement of a well proved analogy method. The panel method is of higher order using linear source and doublet distributions. The transonic flow region is removed from the entire flow field and the panel method is used for calculating boundary values for the subsequent finite difference method. The finite difference method solves the full potential equation in streamline coordinates

N82-13096*# Boeing Military Airplane Development, Seattle,

PREDICTION OF SUBSONIC AIRCRAFT FLOWS WITH JET **EXHAUST INTERACTIONS**

D W Roberts In AGARD Aerodyn of Power Plant Installation Sep 1981 12 p refs

(Contract NAS2-10100)

Avail NTIS HC A22/MF A01 CSCL 02A

A numerical procedure to calculate the flow fields resulting from the viscous inviscid interactions that occur when a strong jet exhaust and aircraft flow field coupling exists was developed The approach divides the interaction region into zones which are either predominantly viscous or inviscid. The flow in the inviscid zone which surrounds most of the aircraft is calculated using an existing potential flow code. The viscous flow zone, which encompasses the jet plume, is modeled using a parabolized Navier-Stokes code The procedure features the coupling of the zonal solutions such that sufficient information is transferred between the zones to preserve the effects of the interactions The zonal boundaries overlap and the boundary conditions are the information link between zones. An iteration scheme iterates the coupled analysis until convergence has been obtained EAK

N82-13097# Douglas Aircraft Co., Inc., Long Beach, Calif PROP-FAN INTEGRATION AT CRUISE SPEEDS

H Robert Welge In AGARD Aerodyn of Power Plant Installation Sep 1981 14 p refs

Avail NTIS HC A22/MF A01

The aerodynamic installation features of a highly loaded turboprop (prop fan) on an aircraft for flight at Mach 08 are discussed The aerodynamic flow environment in which the prop fan must operate is shown for both wing and aft-fuselage installations using advanced surface panel methods. The effects of prop fan slipstream parameters on the drag of a supercritical wing are presented indicating that only small drag penalties occur Drag reductions are possible by tailoring the local wing section to account for the rotor induced flow. Using these inputs, an integrated wing/nacelle is shown EAK

N82-13098*# Boeing Commercial Airplane Co., Seattle, Wash New Product Development Dept

AIRFRAME PROPULSION SYSTEM AERODYNAMIC INTERFERENCE PREDICTIONS AT HIGH TRANSONIC MACH NUMBERS INCLUDING OFF-DESIGN ENGINE AIRFLOW EFFECTS

R M Kulfan and A Sigalta In AGARD Aerodyn of Power Plant Installation Sep 1981 23 p refs

(Contract NAS1-14623)

Avail NTIS HC A22/MF A01 CSCL 02A

The transonic speed regime for airplanes at conditions where inlet spillage takes place is discussed. A wind tunnel test program to evaluate aerodynamic performance penalties associated with propulsion system installation and operation at subsonic through low supersonic speeds was conducted. The accuracy of analytic methods for predicting transonic engine airframe interference effects was assessed Study variables included Mach number,

angle of attack, relative celle location, and nacelle mass flow ratio Results include test theory comparisons of forces as well as induced pressure fields. Prediction capability of induced shock wave strength and locations is assessed. It was found that large interference forces due to engine location and flow spillage occur at transonic speeds, that theory explains these effects, and that theory can predict quantitatively these effects

N82-13104 Iowa Univ Oakdale TURBULENT WAKE DEVELOPMENT BEHIND STREAM-LINED BODIES Ph D Thesis

Sastry Suryanarayana Munukutla 1981 316 p Avail Univ Microfilms Order No 8123346

The developing turbulent wake behind streamlined bodies is reported Detailed measurements of mean and turbulent flow properties are made in three different wake flows. The first is the symmetric wake of a flat plate, the second is the asymmetric wake of a flat plate, (asymmetry being produced by roughening on side of the plate) and the third is the curved wake of an asymmetric airfoil at incidence. It is possible to identify three important regions in the wake, namely the near wake, intermediate wake and the far wake. The performance of the existing turbulence models in the case of the symmetric flat plate wake is studied. The near and intermediate wake regions are predicted by a sophisticated turbulence model Dissert Abstr

N82-13106*# National Aeronautics and Space Administration

Langley Research Center Hampton, Va
FORCE AND MOMENT, FLOW-VISUALIZATION, AND BOUNDARY-LAYER TESTS ON A SHUTTLE ORBITER MODEL AT MACH 6

Robert L Calloway Dec 1981 25 p refs (NASA-TP-1952, L-14782) Avail NTIS HC A02/MF A01 CSCL 01A

Force and moment, flow visualization, and boundary layer state tests were conducted using two 0 004 scale shuttle orbiter models. The force and moment tests were conducted for an angle of attack range from 20 to 40 deg and for Reynolds numbers based on reference length from 0.4 million to 3.6 million Schlieren photographs were obtained for each angle of attack and Reynolds number. The boundary layer state tests, which were conducted using hot film sensors mounted in a separate model, were conducted over the same range of conditions as the force tests. Test results were combined to show that changes in the boundary layer on a typical hypersonic force test model affect measurement of the axial force coefficient and that the state of the local boundary layer is important for interpreting hypersonic aerodynamic test results

N82-13107*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

WIND-TUNNEL INVESTIGATION OF THE EFFECTS OF BLADE TIP GEOMETRY ON THE INTERACTION OF TORSIONAL LOADS AND PERFORMANCE FOR AN ARTICULATED HELICOPTER ROTOR

William T Yeager and Wayne R Mantay Dec 1981 64 p refs Prepared in cooperation with Army Aviation Research and Development Command, Hampton, Va

(DA Proj 1L2-62209-AH-76)

(NASA-TP-1926, AVRADCOM-TR-81-B-5 L-14674) Avail NTIS HC A04/MF A01 CSCL 01A

The Langley transonic dynamics tunnel was used to determine the degree of correlation between rotor performance and the dynamic twist generated by changes in blade tip geometry using an articulated rotor with four different tip geometries at advance ratios of 0.20, 0.30 and 0.35. Based on the data obtained, it is concluded that (1) there appears to be no strong correlation between blade torsion loads and rotor performance prediction. (2) for a given rotor task at each advance ratio investigated, both the azimuthal variation of torsional moment and the mean torsional moment at 81% radius are configuration dependent, (3) reducing the nose down twist on the advancing blade appears to be more important to forward flight performance than increasing the nose down twist on the retreating blade. (4) the rotor inflow model used was important in predicting the performance of the adaptive rotor, and (5) neither rigid blade solidity effects, inflow environment, nor blade torsion loads can be used alone to accurately predict active rotor performance

ARH

N82-13109# National Aerospace Lab , Tokyo (Japan)
AN AERODYNAMIC DESIGN AND THE OVERALL STAGE

PERFORMANCE OF AN AIR-COOLED AXIAL-FLOW TURBINE

Atsumasa Yamamoto Kitao Takahara Hiroyuki Nouse, Shigeo Inoue, Hiroschi Usui, and Fugio Mimura Jan 1981 44 p refs (NAL-TR-321T) Avail NTIS HC A03/MF A01

In order to investigate air-cooled turbines for application to high-temperature engines, a single stage turbine with a 0.56-m (22-inch) tip diameter was designed. The aerodynamical design procedures of the turbine are presented. The stator and rotor blades are characterized by low blade solidity, thick blade section, blunt leading edge and trailing edge and low blade aspect ratio. A cold air test without supply of cooling air was conducted to determine the turbine aerodynamic performance. The highest efficiency obtained over the range of conditions investigated was 0 865 The turbine satisfied the equivalent design value of specific work output at the design condition (i.e., at equivalent design speed and equivalent design pressure ratio) with an efficiency of 0.856 Detailed surveys of rotor-outlet gas flow were made with Pitot tubes and temperature sensors and the results are also presented

N82-13110*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va PRESSURE DISTRIBUTIONS ON THREE DIFFERENT

CRUCIFORM AFT-TAIL CONTROL SURFACES OF A WINGLESS MISSILE AT MACH 1.60, 2.36, AND 370 VOLUME 1. TRAPEZOIDAL TAIL

Milton Lamb Wallace C Sawyer, Donald L Wassum, and C Donald Babb Aug 1979 345 p

(NASA-TM-80097 L-12993-Vol-1)

HC A15/MF A01 CSCL 01A

The results of pressure distribution tests conducted in a wind tunnel are presented without analysis. The data were obtained for trapezoidal aft tail control surfaces on a wingless missile model at Mach numbers of 160, 236, and 370 for angles of attack from -4 to 20 deg model roll angles from 0 to 90 deg and tail deflections of 0 and -15 deg. The test Reynolds number used was 6.6 million per meter MDK

N82-13112*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

THRUST MODULATION METHODS FOR A SUBSONIC V/STOL AIRCRAFT

Richard R Woollett 1981 18 p refs Presented at V/STOL Conf., Palo Alto, Calif., 7-9 Dec 1981 sponsored by AIAA and NASA Ames

(NASA-TM-82747 E-1063) Avail NTIS HC A02/MF A01 CSCL 01A

Low speed wind tunnel tests were conducted to assess four methods for attaining thrust modulation for V/STOL aircraft. The four methods were (1) fan speed change, (2) fan nozzle exit area change, (3) variable pitch rotor (VPR) fan, and (4) variable inlet guide vanes (VIGV). The interrelationships between inlet and thrust modulation system were also investigated using a double slotted inlet and thick lip inlet. Results can be summarized as (1) the VPR and VIGV systems were the most promising, (2) changes in blade angle to obtain changes in fan thrust have significant implications for the inlet, and (3) both systems attained required level of thrust with acceptable levels of fan blade

N82-13115# Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany)

A CALCULATION METHOD FOR SLENDER WING-BODY CONFIGURATIONS IN SUPERSONIC FLOW AT HIGH ANGLES OF ATTACK [EIN BERECHNUNGSVERFAHREN FUER SCHLANKE FLUEGEL-RUMPFANORDNUNGEN IM UEBERSCHALL BEI HOHEN ANSTELLWINKELN]

D Nikolitsch Bonn Bundesministerium der Verteidigung 1979 58 p refs in GERMAN ENGLISH summary Sponsored by Bundesministerium der Verteidigung (BMVg-FBWT-79-15) Avail NTIS HC A04/MF A01, DOK-

ZENTBw. Bonn DM 30

An analysis which determines nonlinear force and pitching moment characteristics of slender bodies and slender wing-body configurations at high angles of attack in supersonic flow is presented. The linear coefficients of the body are calculated by means of a singularity distribution along the body axis. The nonlinear coefficients are determined by a method based on Wardlaw's multivortex model which is modified so that it is applicable at Mach > 1 The wing characteristics are calculated

with the Huerlimann prediction method this method is limited to slender, tapered wing planforms. The mutual interference of wing and body is accounted for by Nielsen interference factors The range of application of the analysis is exemplified by sample calculations Author (ESA)

N82-13116# Messerschmitt-Boelkow-Blohm G m b H, Munich (West Germany) Unternehmensbereich Flugzeuge

FINAL REPORT ON THE FUEFO-4 MAJOR THEME. INTERFERENCE DRAG WITH AIRFRAME/ENGINE INTE-GRATION ON FIGHTER AIRCRAFT Final Report [ABSCHL-USSBEREICHT ZUM RUEFO-4 RAHMENTHEMA INTER-FERENZWIDERSTAND BEI DER ZELLEN-/ TREIBWERKSINTEGRATION VON KAMPFFLUGZEUGEN') H L Weinreich and R Smyth (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany) Bonn Bundesministerium der Verteidigung 1979 182 p refs. In GERMAN Sponsored by Bundesministerium der ENGLISH summary Verteidigung

(BMVg-FBWT-79-20) Avail NTIS HC A09/MF A01, DOK-ZENTBw, Bonn DM 40

Theoretical and experimental (wind tunnel) studies of engine nozzle characteristics as well as of engine/airframe aerodynamic interaction are summarized. Results significant to fighter aircraft configuration optimization are identified. Wind tunnel experiment design is also critically assessed Results emphasized concern experimental data for parameters influencing afterbody drag, theoretical and construction concepts of variable CONDI nozzles theoretical methods for the correction of wind tunnel data the synthesis of inlet drag and investigations of jet decay structures Author (ESA)

N82-13131*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

GROUP 1. SCENARIO DESIGN AND DEVELOPMENT ISSUES

Peter Sherwin In its Guidelines for Line-oriented Flight Training. Vol 2 1981 p 113-117

Avail NTIS HC A08/MF A01 CSCL 051

All LOFf scenarios and flight segments should be designed on the basis of a detailed statement of specific objectives. These objectives must state what kind of situation is to be addressed and why The origin, routing, and destination of a particular scenario should be dictated by the specific objectives for that scenario or leg. Other factors to be considered are the desired weather, climate, etc. Simulator visual system, as well as other capabilities and limitations must be considered at a very early stage of scenario design. The simulator navigation area must be apropriate and must coincide with current Jeppeson charts. Much of the realism of LOFT is destroyed if the crew is unable to use current manuals and other materials

N82-13135# SCI Systems, Inc., Huntsville, Ala TECHNIQUES FOR INTERFACING MULTIPLEX SYSTEMS Final Report, 10 Sep. 1979 - 10 May 1980 James P Gross Feb 1981 138 p (Contract F33615-79-C-1878 AF Proj 2003)

AFWAL-TR-80-1223) (AD-A101457.

NTIS Avail HC A07/MF A01 CSCL 17/2

Data describing the characteristics of a number of aircraft multiplex systems were collected and compiled Although Air Force aircraft received priority, were consideration was also given to other military and commercial aircraft. The F-16, B-52 OAS. YAH-64, F-18, F-15 and ARINC 575 systems were included MIL-STD-1553B was used as a baseline for comparison. The compiled data was analyzed to determine points of incompatibility between these systems and a feasibility study was performed to assess possible techniques to be used in achieving bus compatibility. A programmable interface module design philosophy is recommended which utilizes a distributed three-microprocessor arrangement to achieve the desired interface compatibility. The three-processor conept allows three independent softwarecontrolled events to occur simultaneously, thus providing an extremely high degree of flexibility both for existing systems and for future growth Author

N82-13136# Institute for Defense Analyses, Arlington, Va Program Analysis Div

TRENDS DURING DEVELOPMENT AND PRODUCTION **Final Report**

Norman J Asher Lee L Douglas, and Ray H Jakobovits Jul 1981 279 p refs Revised (Contract MDA903-79-C-0320)

(AD-A105775, AD-E500409, IDA/HQ-81-23636) Avail NTIS HC A13/MF A01 CSCL 01/3

This study updates and extends IDA Study S-451, 'Changes in Helicopter Reliability/Maintainability Characteristics Over Time, dated March 1975. This study presents more recent data and, based on the combined data of both studies, summarizes the observed helicopter R&M trends. Trends observed during the development phase are compared with those of the production

N82-13137# Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany) Unternehmensbereich Drehfluegler und Verkehr

SYSTEM IDENTIFICATION HELICOPTER PARAMETERS. DETERMINATION FROM FLIGHT TESTS, PHASE 2 SYSTEMIDENTIFIZIERUNG DREHFLUEGLER KENNWERT-ERMITTLUNG AUS FLUGMESSUNGEN (PHASE 2)]

M Kloster and S Attlfellner Bonn Bundesministerium der Verteidigung 1980 92 p refs in GERMAN ENGLISH summary Sponsored by Bundesministerium der Verteidigung (BMVg-FBWT-80-12) Avail NTIS HC A05/MF A01, DOK-

ZENTW, Bonn DM 30

A parameter identification program for a hingeless rotor helicopter is considered. Flight conditions were selected with increasing instability, i.e., hover and level flight at maximum speed, with maximum weight and with a rearward center of gravity. A strap down system was chosen to provide the attitude feedback control necessary for proper identification. The control input signals were optimized for the unstabilized helicopter Calculations in the time and frequency domains show that special distributions in the power spectrum of the input signals are needed for optimizing the closed loop system. The identified derivatives and the smoothened time histories from flight tests are compared with the identification results of linear and nonlinear simulations and of the quasistatic theory Author (ESA)

N82-13138# Vereinigte Flugtechnische Werke G m b H , Bremen (West Germany)

MANEUVER LOAD CONTROL FOR THE REDUCTION OF DESIGN LOADS AND IMPROVEMENT OF THE MANEUVER-ABILITY OF MODERN FIGHTER AIRCRAFT

Horst Balke Bonn Bundesministerium der Verteidigung 1981 283 p refs in GERMAN ENGLISH summary Sponsored by Bundesministerium der Verteidigung

(BMVg-FBWT-81-2) Avail NTIS HC A13/MF A01, DOK-ZENTBw Bonn DM 50

Active control technology is applied and the feasibility of design load reduction is analyzed. The influence of direct force control on aircraft component loads and on aircraft maneuverability is seen. The deflection of secondary control surfaces in proportion with the commanded control surface was investigated in an open loop control system. Load reduction efficiency diagrams and tables are presented. A comparison of two different aircraft shows that with an open loop control system a considerable reduction in design load is possible. The loads acting on several aircraft components for different open loop control systems are compared Several closed loop control systems with aircraft response feedback parameters were also investigated. The results are again presented as diagrams, and tables. Only in some cases does closed loop control achieve better results than open loop control. The best design load reduction is achieved with a combined open and closed loop control system. The investigation results are comprehensively evaluated and the parameters relevant for design load reduction are summarized Author (ESA)

N82-13139 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div

RAVEN AIRCRAFT FILTER-ABSORBER

Jerzy Chojnacki 26 Nov 1980 5 p Transl into ENGLISH from Skrzydlata Polska (Poland), Vol 1, no 51-52, 1979 p 7 (AD-A098962, FTD-ID(RS)T-2017-80) HC A02/MF A01 CSCL 06/11

A filter-absorber in the shape of a rectangular box and weighing 9.5 kg is mounted outside the cockpit of an agricultural aircraft Toxic compounds given off during crop spraying are trapped by internal filters. The first, or forward filter has Anilana

fibers. The second, or actual purification filter, is made from fiberglass which absorbs the finest airborne contaminants. The pesticide filter-absorber device is quaranteed for 100 hours of operation and was designed for use in Africa

N82-13140*# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France)

PRACTICAL ASPECTS OF INSTRUMENTATION SYSTEM INSTALLATION, VOLUME 13

R W Borek, A Pool, ed and K C Sanderson, ed Sep 1981 197 p refs

(NASA-TM-84067, AGARD-AG-160-Vol-13,

ISBN-92-835-1399-1) Avail NTIS HC A09/MF A01 CSCL 01D

A review of factors influencing installation of aircraft flight test instrumentation is presented. Requirements, including such factors as environment, reliability, maintainability, and system safety are discussed. The assessment of the mission profile is followed by an overview of electrical and mechanical installation factors with emphasis on shock/vibraion isolation systems and standardization of the electric wiring installation, two factors often overlooked by instrumentation engineers. A discussion of installation hardware reviews the performance capabilities of wiring, connectors, fuses and circuit breakers, and a guide to proper selections is provided. The discussion of the installation is primarily concerned with the electrical wire routing, shield terminations and grounding. Also inclued are some examples of installation mistakes that could affect system accuracy. System verification procedures and special considerations such as sneak circuits, pyrotechnics, aircraft antenna patterns, and lightning strikes are discussed MDK

N82-13141# General Electric Co., Binghamton, N.Y. Aircraft Equipment Öiv

ELECTRONIC MASTER MONITOR AND ADVISORY DISPLAY SYSTEM TEST AND DEMONSTRATION REPORT Interim Report, Jan. - Jun 1981

Jun 1981 52 p

(Contract DAAK80-79-C-0270)

(AD-A105317, ACS-12388, AVRADCOM-TR-79-0270-5 IR-5) Avail NTIS HC A04/MF A01 CSCL 01/4

The hardware and software of the electronic master monitor and advisory display system are tested. The results are documented and the feasibility of the system is demonstrated

N82-13142*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

NUMERICAL ANALYSIS OF THE SCRAMJET-INLET FLOW FIELD BY USING TWO-DIMENSIONAL NAVIER-STOKES EQUATIONS

Alay Kumar Dec 1981 30 p refs

(NASA-TP-1940 L-14776) Avail NTIS HC A03/MF A01 CSCL 21F

A computer code was developed to solve the full two dimensional Navier-Stokes equations in a supersonic combustion ramjet (scramjet) inlet. In order to be able to consider a general inlet geometry with embedded bodies, a numerical coordinate transformation is used which generates a set of boundary-fitted curvilinear coordinates. The explicit finite difference algorithm of MacCormack is used to solve the governing equations. An algebraic, two-layer eddy-viscosity model is used for the turbulent flow. The code can analyze both inviscid and viscous flows with no strut, one strut, or multiple struts in the flow field. The application of the two dimensional analysis in the preliminary parametric design studies of a scramjet inlet is discussed. Detailed results are presented for one model problem and for several RJF actual scramjet-inlet configurations

N82-13143*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

EFFECT OF FUEL-AIR-RATIO NONUNIFORMITY ON EMISSIONS OF NITROGEN OXIDES

Valerie J Lyons Nov 1981 14 p refs

(NASA-TP-1798, E-648) Avail NTIS HC A02/MF A01 CSCL 21E

The inlet fuel-air ratio nonuniformity is studied to deterine how nitrogen oxide (NOx) emissions are affected. An increase in NOx emissions with increased fuel-air ratio nonuniformity for average equivalence ratios less than 0.7 and a decrease in NOx emissions for average equivalence ratios near stoichiometric is predicted The degree of uniformityy of fuel-air ratio profiles that is necessary to achieve NOx emissions goals for actual engines that use lean, premixed, prevaporized combustion systems is determined $$\rm S\ L$$

N82-13144*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

A REAL TIME PEGASUS PROPULSION SYSTEM MODEL FOR VSTOL PILOTED SIMULATION EVALUATION

James R Mihaloew, Stephen P Roth (Pratt and Whitney Aircraft Group West Palm Beach Fla) and Robert Creekmore (Pratt and Whitney Aircraft Group, West Palm Beach, Fla) 1981 18 p refs Presented at VSTOL Conf. Palo Alto, Calif. 7-9 Dec 1981, sponsored by AIAA and NASA Ames Research Center (NASA-TM-82770 E-1004, AIAA-81-2663) Avail NTIS HC A02/MF A01 CSCL 21E

A real time propulsion system modeling technique suitable for use in man-in-the-loop simulator studies was developed This technique provides the system accuracy, stability and transient response required for integrated aircraft and propulsion control system studies. A Pegasus-Harrier propulsion system was selected as a baseline for developing mathematical modeling and simulation techniques for VSTOL Initially, static and dynamic propulsion system characteristics were modeled in detail to form a nonlinear aerothermodynamic digital computer simulation of a Pegasus engine From this high fidelity simulation a real time propulsion model was formulated by applying a piece-wise linear state variable methodology. A hydromechanical and water injection control system was also simulated. The real time dynamic model includes the detail and flexibility required for the evaluation of critical control parameters and propulsion component limits over a limited flight envelope. The model was programmed for interfacing with a Harrier aircraft simulation. Typical propulsion system simulation results are presented

N82-13145*# Pratt and Whitney Aircraft Group East Hartford, Conn Commercial Products Div

SENSOR FAILURE DETECTION SYSTEM Final Report

E C Beattle R F LaPrad, M E McGlone, S M Rock, and M M Akhter Aug 1981 172 p refs Prepared in cooperation with Systems Control Inc Palo Alto Calif (Contract NAS3-22481)

(NASA-CR-165515 PWA-5736-17) Avail NTIS HC A08/MF A01 CSCL 21E

Advanced concepts for detecting, isolating, and accommodating sensor failures were studied to determine their applicability to the gas turbine control problem. Five concepts were formulated based upon such techniques as Kalman filters and a screening process led to the selection of one advanced concept for further evaluation. The selected advanced concept uses a Kalman filter to generate residuals, a weighted sum square residuals technique to detect soft failures, likelihood ratio testing of a bank of Kalman filters for isolation, and reconfiguring of the normal mode Kalman filter by eliminating the failed input to accommodate the failure. The advanced concept was compared to a baseline parameter synthesis technique. The advanced concept was shown to be a viable concept for detecting, isolating and accommodating sensor failures for the gas turbine applications.

N82-13146*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio

NASA RESEARCH IN AIRCRAFT PROPULSION

Milton A Beheim 1982 17 p Proposed for presentation at the 27th Ann Intern Gas Turbine Conf., London 18-22 Apr 1982, sponsored by ASME

(NASA-TM-82771 E-1096) Avail NTIS HC A02/MF A01 CSCL 21E

A broad overview of the scope of research presently being supported by NASA in aircraft propulsion is presented with emphasis on Lewis Research Center activities related to civil air transports CTOL and V/STOL systems Aircraft systems work is performed to identify the requirements for the propulsion system that enhance the mission capabilities of the aircraft This important source of innovation and creativity drives the direction of propulsion research in a companion effort component research of a generic nature is performed to provide a better basis for design and provides an evolutionary process for technological growth that increases the capabilities of all types of aircraft Both are important.

 ${f N82-13147^*\#}$ Stanford Univ , Calif Dept of Aeronautics and Astronautics

DESIGN FOR ACTIVE AND PASSIVE FLUTTER SUPPRES-

SION AND GUST ALLEVIATION Ph D. Thesis

Mordechay Karpel Washington NASA Nov 1981 117 prefs

(Grant NGL-05-020-243)

(NASA-CR-3482) Avail NTIS HC A06/MF A01 CSCL 01C

Analytical design techniques for active and passive control of aeroelastic systems are based on a rational approximation of the unsteady aerodynamic loads in the entire Laplace domain which yields matrix equations of motion with constant coefficients. Some existing schemes are reviewed, the matrix Pade approximant is modified and a technique which yields a minimal number of augmented states for a desired accuracy is presented. The state-space aeroelastic model is used to design an active control system for simultaneous flutter suppression and gust alleviation. The design target is for a continuous controller which transfers some measurements taken on the vehicle to a control command applied to a control surface. Structural modifications are formulated in a way which enables the treatment of passive flutter suppression system with the same procedures by which active control systems are designed.

N82-13148*# National Aeronautics and Space Administration Langley Research Center, Hampton Va

LIMITED EVALUATION OF AN F-14A AIRPLANE UTILIZING AN AILERON-RUDDER INTERCONNECT CONTROL SYSTEM IN THE LANDING CONFIGURATION

Wendell W Kelley and Einar K Enevoldson (NASA Dryden Flight Research Center) Dec 1981 39 p refs (NASA-TM-81972, L-14756) Avail NTIS HC A03/MF A01 CSCL 01C

A flight test was conducted for preliminary evaluation of an aileron-rudder interconnect (ARI) control system for the F-14A airplane in the landing configuration. Two ARI configurations were tested in addition to the standard F-14 flight control system Results of the flight test showed marked improvement in handling qualities when the ARI systems were used. Sideslip due to adverse yaw was considerably reduced, and airplane turn rate was more responsive to pilot lateral control inputs. Pilot comments substantiated the flight data and indicated that the ARI systems were superior to the standard control system in terms of pilot capability to make lateral offset corrections and heading changes on final approach.

N82-13149*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center, Edwards, Calif ANALYSIS OF A LONGITUDINAL PILOT-INDUCED OSCILLATION EXPERIENCED ON THE APPROACH AND LANDING TEST OF THE SPACE SHUTTLE

John W Smith Dec 1981 45 p refs (NASA-TM-81366) Avait NTIS HC A03/MF A01 CSCL 05H

During the final free flight (FF-5) of the shuttle's approach and landing tests, the vehicle experienced pilot-induced oscillations near touchdown. The light test data showed that pilot inputs to the hand controller reached peak-to-peak amplitudes of 20 deg at a frequency between 3 and 35 radians per second. The controller inputs were sufficient to exceed the priority rate limit set in the pitch axis. A nonlinear analytical study was conducted to investigate the combined effects of pilot input, rate limiting, and time delays. The frequency response of the total system is presented parametrically as a function of the three variables. In general, with no dead time, for controller inputs of 5 deg or less, the total system behaves in a linear fashion. For 10 deg of controller input independent of the delay time, the elevon loop will be rate saturated above a frequency of 4 radians per second.

N82-13150*# Purdue Univ Lafayette Ind School of Aeronautics and Astronautics

INTERACTIVE AIRCRAFT FLIGHT CONTROL AND AERO-ELASTIC STABILIZATION Interim Report

Terrence A Weisshaar and David K Schmidt 31 Oct 1981 39 p refs (Grapt NGC) 157)

(Grant NAG1-157)

(NASA-CR-165036) Avail NTIS HC A03/MF A01 CSCI

Several examples are presented in which flutter involving interaction between flight mechanics modes and elastic wind bending occurs for a forward swept wing flight vehicle. These results show the basic mechanism by which the instability occurs

and form the basis for attempts to actively control such a

N82-13186*# San Jose State Univ , Calif

DEVELOPMENT AND TESTING OF DRY CHEMICALS IN ADVANCED EXTINGUISHING SYSTEMS FOR JET ENGINE NACELLE FIRES Final Report

Robert L Altman, A Campbell Ling, ed., Ludwig A Mayer, and Donald J Myronik Sep 1979 314 p

(Grant NsG-2165)

(NASA-CR-165011) Avail NTIS HC A14/MF A01 CSCL 21B

The effectiveness of dry chemical in extinguishing and delaying reignition of fires resulting from hydrocarbon fuel leaking onto heated surfaces such as can occur in jet engine nacelles is studied. The commercial fire extinguishant dry chemical tried are sodium and potassium bicarbonate, carbonate, chloride, carbamate (Monnex), metal halogen, and metal hydroxycarbonate compounds. Synthetic and preparative procedures for new materials developed, a new concept of fire control by dry chemical agents, descriptions of experiment assemblages to test dry chemical fire extinguishant efficiencies in controlling fuel fires initiated by hot surfaces, comparative testing data for more than 25 chemical systems in a static assemblage with no air flow across the heated surface, and similar comparative data for more than ten compounds in a dynamic system with air flows up to 350 ft/sec are presented

N82-13442 Purdue Univ Lafayette, Ind MEASURED PAVEMENT RESPONSE TO TRANSIENT AIRCRAFT LOADINGS Ph.D Thesis

Thomas Dale White 1981 243 p

Avail Univ Microfilms Order No 8123723

Pavement deformation response to aircraft traffic was studied Linear variable differential transducers (LVDT's) were installed in an active taxiway. The LVDT's were attached to reference rods anchored at 16, 36, 120 and 209 in Basic pavement responses information on how pavement layers accommodate dynamic loads. as well as data to compare vertical deformations predicted by a theoretical model were examined A finite difference solution was used to predict pavement temperatures. The solution is shown to have limited application for predicting pavement temperatures. The pavement response phenomena reported are significant. They expose pavement responses that have been minimized in past research but must now be considered Current theoretical models used in pavement analysis or design are limited in predicting pavement response phenomena. They do not represent the observed compression and extension in a pavement under and away from actual aircraft loads

N82-13457# Dornier-Werke G m b H Friedrichshafen (West

STRUCTURAL DYNAMICS. MODIFIED CALCULATIONS G Hornung and H Roehrle Bonn Bundesministerium der Verteidigung 1981 83 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium der Verteidigung (BMVg-FBWT-81-1) Avail NTIS HC A05/MF A01, DOK-ZENTBw, Bonn DM 30

Calculation methods which give natural and harmonically excited vibrations of modified structures, using the results of the original systems, are presented and tested. Most of the methods are based on a linear approximation, i.e., the individual terms of the equations of motion are subdivided into those of the original system and into corresponding difference terms whose products are subsequently neglected Tests are carried out for simple models as well as for three-dimensionally idealized wind and aircraft structures. Concerning natural vibrations, it is difficult to estimate the achieved accuracy without knowing the exact results. The applied methods are Wielandt iteration and subspace iteration. Using the original natural modes as starting vectors leads to a considerable reduction in computation cost, even with severe modifications. Application of the linear approximation is shown for the reduction of the number of degrees of freedom, which precedes dynamic analysis Author (ESA)

N82-13813 Tennessee Univ , Knoxville PREDICTION OF AERODYNAMIC LOADS ON AIRCRAFTS WITH EXTERNAL STORES AT TRANSONIC SPEEDS Ph D. Thesis

Chandrasekaran Balasubramanyan 1981 204 p Avail Univ Microfilms Order No 8123139

The Integral equation method was applied to calculate the pressure distribution over an arbitrary, three dimensional lifting wing and a three dimensional wing with an external store, kept beneath the wing. A method to calculate the interference effects imposed by an external store on the wing and vice-versa is given. The wing along transonic solution is analyzed and compared with the experimental results and as well as a wing with an external store A theory for the flow field nonlinear velocity prediction is developed, programmed, and applied to a wing with an external store configuration and the flow field velocities are compared with the experimental results. The numerical methods for solving the triple and double integrals with limits to infinity are studied and the application of one such method to the flow field prediction problem is briefly indicated Further extension of this work is indicated with the limitations and advantages Dissert Abstr

N82-13835# Rockwell International Corp., Columbus Ohio North American Aircraft Div INVESTIGATION OF ACOUSTIC INTERACTIONS IN JET THRUST AUGMENTING EJECTORS Final Report, 1 Jan.

1979 - 30 Sep. 1980

J R Campbell, K D Korkan (Ohio State Univ., Columbus), and H Viets (Wright State Univ) 5 Mar 1981 244 p refs (Contract N00019-79-C-0225)

(AD-A106083, NR80H-50) Avail NTIS HC A11/MF A01 CSCL 20/1

The performance of a constant area rectangular ejector with varying mixing length was investigated to determine the aeroacoustic interaction effects. The rectangular ejector investigation was conducted in two phases. The phase one investigation involved the testing of three different aspect ratio rectangular convergent nozzles at pressures between 15-45 psig to determine the acoustic and jet spreading characteristics. From these data a rectangular ejector incorporating endwall and ejector flap blowing was fabricated and investigated at pressure ratios between 20 and 50 These investigations were conducted at ejector flap length (L) to ejector throat widths (W), L/W of 110, 95, 80, 65, 50, 35, 20, and 09 to determine the ejector performance The data for the rectangular ejector configuration investigated showed an aeroacoustic interaction in the present ratio range of 33 - 38 However, the resulting performance was not improved to the degree experienced with axisymmetric ejectors

NTIS

N82-13908*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

EFFECT OF VACUUM EXHAUST PRESSURE ON THE PERFORMANCE OF MHD DUCTS AT HIGH D-FIELD

J Marlin Smith, J L Morgan, and Shih-Ying Wang 1982 13 p refs Presented at the 20th Aerospace Sci Meeting, Orlando, Fla., 11-14 Jan 1982 sponsored by AIAA (Contract DE-AIO1-77ET-10769)

(NASA-TM-82750 DOE/NASA/10769-23, F-1066) Avail NTIS HC A02/MF A01 CSCL 201

The effect of area ratio variation on the performance of a supersonic Hall MHD duct is investigated. Results indicate that for a given combustion pressure there exists an area ratio below which the power generating region of the duct is shock free and the power output increases linearly with the square of the magnetic field. For area ratios greater than this, a shock forms in the power generating region which moves upstream with increasing magnetic field strength resulting in a less rapid raise in the power output. The shock can be moved downstream by either increasing the combustion pressure of decreasing the exhaust pressure. The influence of these effects upon duct performance is presented

N82-13974# Naval Postgraduate School, Monterey, Calif COMPILATION OF ABSTRACTS OF DISSERTATIONS THESES, AND RESEARCH PAPERS SUBMITTED BY CANDIDATES FOR DEGREES, 1 OCTOBER 1979 -30 SEPTEMBER 1980

30 SEPTEMBELL Mar 1981 514 p (AD-A104124, NPS-012-81-002PR)

Abstracts are presented of works submitted in fulfillment of degree requirements in the area of aeronautical, electrical, and mechanical engineering as well as in applied mathematics, applied sciences, and computer sciences Author N82-13975# Naval Postgraduate School, Monterey, Calif A SUMMARY OF THE NAVAL POSTGRADUATE SCHOOL RESEARCH PROGRAM Summary Report, 1 Oct. 1979 -30 Sep. 1980

NTIS

Apr 1981 528 p

(AD-A104112, NPS-012-81-003PR)

HC A23/MF A01 CSCL 05/2

HC A08/MF A01 CSCL 05/1

Two hundred thirty research projects are summarized in the following areas computer science, mathematics, administrative sciences, defense resources management, operations research. national security affairs, physics and chemistry, electrical engineering meteorology aeronautics, oceanography, and mechanical engineering Author

N82-13979# RAND Corp., Santa Monica, Calif A NEW APPROACH TO MODELING THE COST OF OWNERSHIP FOR AIRCRAFT SYSTEMS Interim Report K E Marks, H G Massey, B D Bradley, and J Lu Aug 1981 151 p refs (Contract F49620-77-C-0023) RAND/R-2601-AF) (AD-A104434, NTIS

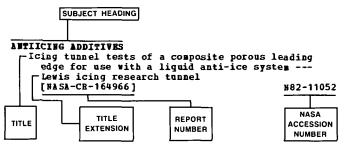
Support investment costs and recurring operations and support costs are through determined using a model for estimating aircraft cost of ownership (MACO), which also provides a framework for future research An outgrowth of an earlier evaluation of the strengths and weaknesses of the most widely used aircraft life cycle cost models, MACO combines algorithms for major, maintenance related costs with formulas drawn from existing models for other cost elements. A full set of ownership cost elements is related to component level reliability and maintainability characteristics and to aircraft design, operations, logistics, and deployment parameters. Resource quantities are computed in units that can be related directly to Air Force programming categories, including base maintenance manning (by work center), depot manning, and recoverable spares inventory levels Output and input parameters accommodate annual changes in system parameters and operating conditions such as component reliability and aircraft inventory size and activity rates

SUBJECT INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Suppl. 146)

MARCH 1982

Typical Subject Index Listing



The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, a title extension is added, separated from the title by hyphens. The NASA or AIAA accession number is included in each entry to assist the user in locating the abstract in the abstract section of this supplement. If applicable, a report number

is also included as an aid in identifying the document A-7 AIRCRAPT Direct digital design method for reconfigurable multivariable control laws for the A-7D Digitac II aircraft A82-14828 Navy spin evaluation of the A-7 airplane configured with automatic maneuvering flaps À82-14933 Performance assessment of the ACBS-II ejection seat-A-10 configuration A82-14980 ABSORBERS (ROUIPHENT) Baven aircraft filter-absorber --- agrıcultural aircraft [AD-A098962] ABSORBERS (MATERIALS) Aircraft absorbers - Promise and practice --sound attenuation A82-14042 AC GENERATORS Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 ACCELEROMETERS A concept for a high-accuracy, low-cost accelerometer A82-14685 ACCIDENT PREVENTION A matter of seconds - A critical account of three notable air disasters /5th Major Miller Memorial A82-15597

An analysis of civil aviation propeller-to-person 1965-1979 accidents: [AD-A105365] N82-12053

ACOUSTIC ATTENUATION Aircraft absorbers - Promise and practice --sound attenuation

A82-14042 Impedance modeling of acoustic absorbing materials for aircraft engine applications

ACOUSTIC DUCTS Impedance modeling of acoustic absorbing materials for aircraft engine applications

A82-14043 ACOUSTIC IMPRDANCE Aircraft absorbers - Promise and practice --sound attenuation

Impedance modeling of acoustic absorbing materials for aircraft engine applications A82-14043 ACTIVE CONTROL Pault isolation methodology for the L-1011 digital avionic flight control system [AIAA 81-2223] A82-13458 On-board communication for active-control transport aircraft [AIAA 81-2321] A82-13520 Maneuver load control for the reduction of design loads and improvement of the maneuverability of modern fighter aircraft [BMVG-PBWT-81-2] N82-13138 Design for active and passive flutter suppression and qust alleviation [NASA-CR-3482] N82-13147 Interactive aircraft flight control and aeroelastic stabilization --- forward swept wing flight vehicles [NASA-CR-165036] N82-13150 ACTUATORS A dual input actuator for fluidic backup flight control A82-13088 Direct digital drive actuation A82-13505 [AIAA 81-2298] Electromechanical actuation development program A82-14705 New all-electric-system technology --electromechanical actuators for aircraft A82-14710 ADAPTIVE CONTROL Wing/store flutter - An active adaptive control application A82-13122 ADAPTIVE PILTERS Pixed gain controller design for aircraft [AD-A104877] N82-12081 ADDITIVES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 ADVANCED TECHNOLOGY LABORATORY A unique integrated flight testing facility for advanced control/display research [AIAA PAPER 81-2490] ABRIAL PECTOGRAPHY Weather impact on low-altitude imaging infrared sensors in Europe - An availability model A82-14779 Current aerial cameras A82-15655 A VHF homing system with VHF radiotelephony for

AERODYNAMIC BALANCE

and 35 mm cameras

Application of the concept of dynamic trim control and nonlinear system inverses to automatic control of a vertical attitude takeoff and landing aircraft [AIAA 81-2238]
Evaluation and wind tunnel tests of the 4,000 lb A82-13466 (normal-force) pitch/yaw and roll dynamic stability balance systems for measuring direct,

inventories, with light aircraft carrying 70 nm

A82-15748

area-representative strip-survey flights

conducted, as part of combined forest

cross, and cross-coupling derivatives [AD-A105122] N82-12047 Evaluation of an experimental technique to

investigate the effects of the engine position on engine/pylon/wing interference N82-13090

A82-14043

A82-14042

Divergence of a sweptforward wing	Development of a comprehensive analysis for rotorcraft. II - Aircraft model, solution
A82-13560	procedure and applications
Himat aerodynamic design and flight test experience	A82-14407
[AIAA PAPER 81-2433] A82-13871	Maneuver load control for the reduction of design
The development of cryogenic wind tunnels and their application to maneuvering aircraft	loads and improvement of the maneuverability of
technology	modern fighter aircraft [BMVG-FBWT-81-2] N82-13138
A82-13971	Prediction of aerodynamic loads on aircrafts with
AD-1 oblique wing aircraft program	external stores at transonic speeds
[AIAA PAPEE 81-2354] A82-14390	N82-13813
Aeroelasticity matters: Some reflections on two	AERODINANIC STABILITY
decades of testing in the NASA Langley transonic dynamics tunnel	Acceptance testing of the Calspan variable
[NASA-TM-83210] N82-12041	stability Learjet A82-14937
Effects of aerodynamic coupling on the dynamics of	System identification helicopter parameters.
roll aircraft	Determination from flight tests, phase 2
N82-12070	[BMVG-FBWT-80-12] N82-13137
Aerodynamics of Power Plant Installation	AERODINANIC STALLING
[AGARD-CP-301] N82-13065	Application of the ONERA dynamic stall model to a
Some BAE research on shielded and unshielded fuselage mounted air intakes at subsonic and	helicopter blade in forward flight [ONERA, TP NO. 1981-89] A82-13992
supersonic speeds	[ONERA, TP NO. 1981-89] A82-13992 Compressor stall inducing installation effects of
N82-13068	an engine control parameter for the CF-5 aircraft
Subsonic military aircraft engine intake: An	N82-13085
integrated theoretical experiment design	AERODYNAMICS
N82-13073	Rapid elliptic solvers
The design and development of the Tornado engine air intake	A82-15827
N82-13074	Remarks on the calculation of transonic potential flow by a finite volume method
Integration of advanced exhaust nozzles	A82-15835
N82-13075	Effect of a part span variable inlet guide vane on
Prop-fan integration at cruise speeds	1F34 fan performance
N82-13097	[NASA-CR-165458] N82-12075
<pre>Porce and moment, flow-visualization, and boundary-layer tests on a shuttle orbiter model</pre>	A look inside the Langley 16-foot transonic
at Mach 6	tunnel: User's guide [NASA-TM-83186] N82-12085
[NASA-TP-1952] N82-13106	Research and Technology
An aerodynamic design and the overall stage	[NASA-TM-83221] N82-13043,
performance of an air-ccoled axial-flow turbine	Prediction of subsonic aircraft flows with jet
[NAL-TR-321T] N82-13109	exhaust interactions
ARRODYNAMIC COEFFICIENTS Analysis of escape systems at 687 KEAS	ARRORLASTICITY N82-13096
A82-14978	Aeroelasticity matters - Some reflections on two
AERODYNAMIC COMPIGURATIONS	decades of testing in the NASA Langley Transonic
Analysis of escape systems at 687 KEAS	Dynamics Tunnel
A82-14978	A82-13969
Subcritical and supercritical airfoils for given	Application of the ONERA dynamic stall model to a
pressure distribution N82-12031	helicopter blade in forward flight
ABRODYNAMIC DEAG	[CNEEA, TP NC. 1981-89] A82-13992 In-flight deflection measurement of the HiMAT
A technique to determine lift and drag polars in	aeroelastically tailored wing
flight and their application	[AIAA PAPER 81-2450] A82-14381
[AIAA PAPER 81-2420] A82-13859	Comparison of wind tunnel and theoretical
A review of flight-to-wind tunnel drag correlation	aeroelastic predictions with flight measured
[AIAA PAPEE 81-2475] A82-14382 Wind tunnel test and analysis techniques using	airloads for the B-1 aircraft [AIAA PAPEE 81-2387] A82-14393
powered simulators for civil nacelle	Aeroelasticity matters: Some reflections on two
installation drag assessment	decades of testing in the NASA Langley transonic
N82-13088	dynamics tunnel
Establishment of an experimental technique to	[NASA-TM-83210] N82-12041
provide accurate measurement of the installed drag of close coupled civil nacelle/airframe	Design for active and passive flutter suppression
configurations, using a full span model with	and gust alleviation [NASA-CR-3482] N82-13147
turbine powered engine simulators	Interactive aircraft flight control and
N82-13089	aeroelastic stabilization forward swept wing
Prop-fan integration at cruise speeds	flight vehicles
N82-13097	[NASA-CR-165036] N82-13150
AERODYNAMIC PORCES	AERONAUTICAL BUGINEBRING
An investigation of F-16 nozzle-afterbody forces at transonic Mach numbers with emphasis on model	Aeronautics in China - An AIAA report Book A82-13150
scale effects	Progress in aeronautical research and technology
[AD-A104905] N82-12392	applicable to civil air transports
AERODYNAMIC INTERFERENCE	A82-13974
Airframe-propulsion system aerodynamic	Index of National Aviation Pacilities Experimental
interference predictions at high transonic Mach numbers including off-design engine airflow	Center technical reports 1972 - 1977
effects	[AD-A104759] N82-12056 Research and Technology
N82-13098	[NASA-TM-83221] N82-13043
AERODYHAMIC LOADS	WASA research in aircraft propulsion
Determining hinge moments and empennage airload	[NASA-TM-82771] N82-13146
parameters from flight data for Learjet airplanes	Compilation of abstracts of dissertations theses,
A82-13120 Improved techniques for the calibration and	and research papers submitted by candidates for
measurement of in-flight loads	degrees, 1 October 1979 - 30 September 1980 [AD-A104124] N82-13974
[AIAA PAPEE 81-2502] A82-13924	ABBONAUTICS
-	Aeronautics in China - An AIAA report Book
	A 82-13150

SUBJECT INDEX AIR TRAFFIC CONTROL

The payoff from U.S. investment in aeronau	tical	An update of an integrated CNI system - TIES	
research and development	107-10702	Communication, Navigation, and Identificat	
A summary of the Naval Postgraduate School	A82-14793	provided by Tactical Information Exchange [AIAA 81-2292] A	82-13500
Research Program		Time-referencing of data in an asynchronous	
[AD-A104112]	N82-13975	environment for fighter aircraft avior	
ABROSOLS Raven aircraft filter-absorber agricul	tural	[AIAA 81-2341] A Loran-C prototype navigation receiver for	82-13531
aircraft	cului	qeneral aviation	
[AD-A098962]	N82-13139		82-13532
ARROSPACE SYSTEMS NAECON 1981; Proceedings of the National A	AFOSD3CO	Estimation of the efficiency of radioelectro flight navigation systems	DIC
and Electronics Conference, Dayton, OH,			82-13701
19-21, 1981. Volumes 1, 2 & 3	-	Instrumentation to determine the suitability	
A EROTERMODYN AMICS	A82-14676	ENAV systems for helicopter navigation in national airspace system /NAS/	the
A real time Fegasus propulsion system mode	1 for		82-13911
VSTOL piloted simulation evaluation		Navstar Global Positioning System flight tes	
[NASA-TM-82770]	N82-13144	program overview	02 43056
AFTERBODIES An investigation of F-16 nozzle-afterbody	forces	[AIAA PAPER 81-2350] Evaluating sources of error in EAR/GEANS	82-13956
at transonic Mach numbers with emphasis		navigation using a Kalman postprocessor	-
scale effects	100.00	Electronically Agile Radar/Gimbaled Electronically	ically
[AD-A104905] Aerodynamics of Power Plant Installation	N82-12392	susp∈nded gyro Airborne Navigation System	82-14739
[AGARD-CP-301]	N82-13065	The agile transversal filter - A flexible by	
Aerodynamic aspects of a high bypass ratio	engine	block for ICNIA, Integrated Communication	
installation on a fuselage afterbody	NO. 12002	Navigation and Identification Avionics	.00 10766
AGRICULTURAL AIRCRAPT	N82-13093	Application of multiple model estimation	182-14765
Raven aircraft filter-absorber agrıcul	tural	techniques to a recursive terrain height	
aircraft	non 12120	correlation system	00 40360
[AD-A098962] AH-64 HRLICOPTER	N82-13139	Technical/operational ATC scenarios for future	182-14768
The TADS/PNVS 'eyes' for the AH-64 attack	helicopter	navigation	-10 100
17177076	A82-13239		182-14774
AILBROWS Trim tan excitation system for the BAe 146		The LABTIEN wide field-of-view raster Head-Upper Display Low Altitude Navigation and) þ
112 tab excited to a the pie 140	A82-14363	Targeting IR for Night	
Limited evaluation of an F-14A airplane ut			82-14825
an alleron-rudder interconnect control s the landing configuration	ystem in	AIR TO AIR MISSILES Integrated Flight/Weapon Control design and	
[NASA-TM-81972]	N82-13148	evaluation	
AIR COOLING			182-14741
The operational characteristics of turboje		AIR TO AIR BEFUELING	182-14741
The operational characteristics of turboje giving particular attention to the coole		AIR TO AIR BEFURLING KC-10, flight test program management - The	182-14741
The operational characteristics of turboje		AIR TO AIR BEFUELING KC-10, flight test program management - The contractor's Viewpoint	182-14741
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stage	A82-14414 e	AIR TO AIR BEFUELING KC-10, flight test program management - The contractor's viewpoint [AIAM FAPER 81-2380] AIR TO SUBFACE MISSILES	
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine . An aerodynamic design and the overall stag performance of an air-cooled axial-flow	d 182-14414 e turbine	AIR TO AIR BEFUELING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SUBPACE MISSILES Integrated Flight/Weapon Control design and	
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stage	A82-14414 e	AIR TO AIR BEFUELING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURFACE MISSILES Integrated Flight/Weapon Control design and evaluation	
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TB-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv	M82-14414 e turbine N82-13109	AIR TO AIR BEFUELING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SUBFACE MISSILES Integrated Flight/Weapon Control design and evaluation AIR TRAFFIC CONTEOL	482-14384 482-14741
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS *** Experimental and analytical studies of adv	A82-14414 e turbine N82-13109	AIR TO AIR BEFUELING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURFACE MISSILES Integrated Flight/Weapon Control design and evaluation AIR TRAFFIC CONTROL Puel efficient flight profiles in an ATC flo	482-14384 482-14741
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TB-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv	M82-14414 e turbine N82-13109	AIR TO AIR BRFUELING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SUBPACE MISSILES Integrated Flight/Weapon Control design and evaluation AIR TRAFFIC CONTEOL Fuel efficient flight profiles in an ATC flow management environment	482-14384 482-14741
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TB-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CB-3476] AIR FILTERS Raven aircraft filter-absorber agricul	A82-14414 e turbine N82-13109 anced	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAM PAPER 81-2380] AIR TO SUBPACE MISSILES Integrated Flight/Weapon Control design and evaluation AIR TRAPPIC CONTROL Puel efficient flight profiles in an ATC flowanagement environment Technical/operational ATC scenarios for fute	482-14384 482-14741 DW 462-13078
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft	A82-14414 e turbine N82-13109 anced N82-12065	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURPACE MISSILES Integrated Flight/Weapon Control design and evaluation AIR TRAPPIC CONTROL Puel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for future navigation	A82-14384 A82-14741 DW A62-13078 ITE TMA
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962]	A82-14414 e turbine N82-13109 anced	AIR TO AIR BRPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURPACE MISSILES Integrated Flight/Weapon Control design and evaluation AIR TRAFFIC CONTROL Fuel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for future navigation	82-14384 882-14741 DW 862-13078 BICE TMA 882-14774
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft	A82-14414 e turbine N82-13109 anced N82-12065 tural	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURPACE MISSILES Integrated Flight/Weapon Control design and evaluation AIR TRAPPIC CONTROL Puel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for future navigation	82-14384 882-14741 DW 862-13078 BICE TMA 882-14774
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressurand airflow distribution for gas turbine	A82-14414 e turbine N82-13109 anced N82-12065 tural N82-13139 are loss	AIE TO AIE BEFUELING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SUBPACE MISSILES Integrated Flight/Weapon Control design and evaluation AIE TEAPPIC CONTEOL Puel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for futuravigation Some Italian research for developing new proacts and atc radars	A82-14384 A82-14741 DW A82-13078 AR2-14774 HARZ-14774
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TB-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CB-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressures	A82-14414 e turbine N82-13109 anced N82-12065 tural N82-13139 are loss	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURPACE MISSILES Integrated Flight/Weapon Control design and evaluation AIR TRAFFIC CONTROL Fuel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for future navigation Some Italian research for developing new product and arc radars Performance evaluation of target report extinguished.	82-14384 882-14741 0W 862-13078 Bre TMA 882-14774 Basy 882-14775 Factor
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressurand airflow distribution for gas turbine	A82-14414 e turbine N82-13109 anced N82-12065 tural N82-13139 are loss	AIE TO AIE BEFUELING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SUBPACE MISSILES Integrated Flight/Weapon Control design and evaluation AIE TEAPPIC CONTEOL Puel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for futuravigation Some Italian research for developing new proacts and atc radars	82-14384 882-14741 0W 862-13078 Bre TMA 882-14774 Basy 882-14775 Factor
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the King MK.50 helicopter	A82-14414 e turbine N82-13109 anced N82-12065 .tural N82-13139 are loss .	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SUBPACE MISSILES Integrated Flight/Weapon Control design and evaluation AIR TRAPPIC CONTROL Puel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for future navigation Some Italian research for developing new product of the control of the	A82-14384 A82-14741 A82-13078 A82-14774 A82-14774 A82-14775 Cactor Datrol
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the King MK.50 helicopter [AD-A105211]	A82-14414 e turbine N82-13109 anced N82-12065 tural N82-13139 are loss	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURPACE MISSILES Integrated Plight/Weapon Control design and evaluation AIR TRAFFIC CONTROL Fuel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for future navigation Some Italian research for developing new product of the profiles of the p	A82-14384 A82-14741 A82-13078 A82-14774 A82-14774 A82-14775 Cactor Datrol
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the King MK.50 belicopter [AD-A105211] AIR INTAKES	A82-14414 e turbine N82-13109 anced N82-12065 tural N82-13139 are loss A82-15606 e Sea N82-12069	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURPACE MISSILES Integrated Plight/Weapon Control design and evaluation AIR TRAPPIC CONTEOL Puel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for futuravigation Some Italian research for developing new properties and the monopulse ATCRBS Air Traffic Control Radar Beacon System A multimicroprocessor system for ATCRBS monodata processing	A82-14384 A82-14741 A82-13078 A82-14774 A82-14774 A82-14775 Cactor Datrol
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the King MK.50 helicopter [AD-A105211]	A82-14414 e turbine N82-13109 anced N82-12065 .tural N82-13139 are loss A82-15606 e Sea N82-12069	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURPACE MISSILES Integrated Flight/Weapon Control design and evaluation AIR TRAFFIC CONTROL Fuel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for future navigation Some Italian research for developing new product and arc radars Performance evaluation of target report extra in the monopulse ATCRBS Air Traffic Control Radar Beacon System A multimicroprocessor system for ATCRBS monodata processing A new approach to radar plot extraction for	A82-14384 A82-14741 A82-13078 A82-14774 A82-14775 Factor Fortrol A82-14776 A82-14776 A82-14777
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the king MK.50 helicopter [AD-A105211] AIR INTAKES Transcnic flows in an air inlet with large incidence and the effect of a blowing tr	A82-14414 eturbine N82-13109 anced N82-12065 tural N82-13139 are loss A82-15606 e Sea N82-12069	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURPACE MISSILES Integrated Plight/Weapon Control design and evaluation AIR TRAPPIC CONTEOL Puel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for futuravigation Some Italian research for developing new practice radars Performance evaluation of target report extinate monopulse ATCRBS Air Traffic Control Radar Beacon System A multimicroprocessor system for ATCRBS monopulse applications	A82-14741 A82-14741 A82-13078 A82-14774 A82-14777 A82-14776 Depulse A82-14777 ATC
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the King MK.50 helicopter [AD-A105211] AIR INTAKES Transcnic flows in an air inlet with large incidence and the effect of a blowing tr	A82-14414 eturbine N82-13109 anced N82-12065 tural N82-13139 are loss A82-15606 e Sea N82-12069	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SUBPACE MISSILES Integrated Flight/Weapon Control design and evaluation AIR TRAPPIC CONTEOL Puel efficient flight profiles in an ATC flow management environment Technical/operational ATC scenarios for future navigation Some Italian research for developing new property and the monopulse ATCRBS Air Traffic Control Radar Beacon System A multimicroprocessor system for ATCRBS moned at a processing A new approach to radar plot extraction for applications	A82-14384 A82-14741 A82-13078 A82-14774 A82-14775 Factor Fortrol A82-14776 A82-14776 A82-14777
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TB-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the King MK.50 helicopter [AD-A105211] AIR INTARES Transcnic flows in an air inlet with large incidence and the effect of a blowing trust of air inlets	A82-14414 eturbine N82-13109 anced N82-12065 tural N82-13139 are loss A82-15606 e Sea N82-12069	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURPACE MISSILES Integrated Plight/Weapon Control design and evaluation AIR TRAFFIC CONTROL Fuel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for future navigation Some Italian research for developing new product and are reported at the monopulse ATCRBS Air Traffic Control Radar Beacon System A multimicroprocessor system for ATCRBS monopulse and processing A new approach to radar plot extraction for applications Extended time radar raw video recording	A82-14384 A82-14741 A82-14741 A82-14774 A82-14775 Cactor Control A82-14776 A82-14777 ATC A82-14908
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FLITERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the King MK.50 helicopter [AD-A105211] AIR INTAKES Transcnic flows in an air inlet with large incidence and the effect of a blowing trust of air inlets Studies of air inlets at Reynolds numbers	A82-14414 e turbine N82-13109 anced N82-12065 tural N82-13139 are loss A82-15606 e Sea N82-12069 N82-13071 anic	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURPACE MISSILES Integrated Plight/Weapon Control design and evaluation AIR TRAPPIC CONTEOL Puel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for future navigation Some Italian research for developing new product radars Performance evaluation of target report extinate monopulse ATCRBS Air Traffic Contract Radar Beacon System A multimicroprocessor system for ATCRBS monopulse applications Extended time radar raw video recording Large terminal maneuvering areas: Operations	A82-14384 A82-14741 A82-14774 A82-14774 A82-14775 Factor Control A82-14777 A82-14777 ATC A82-14908
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the King MK.50 helicopter [AD-A105211] AIR INTAKES Transcnic flows in an air inlet with large incidence and the effect of a blowing trests of air inlets Studies of air inlets at Reynolds numbers comparable to flight in CHERA'S F1 and S	A82-14414 e turbine N82-13109 anced N82-12065 tural N82-13139 are loss A82-15606 e Sea N82-12069 N82-13071 anic	AIE TO AIE BEFUELING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SUBPACE MISSILES Integrated Flight/Weapon Control design and evaluation AIE TRAFFIC CONTEOL Puel efficient flight profiles in an ATC flow management environment Technical/operational ATC scenarios for future navigation Some Italian research for developing new property and the monopulse ATCRBS Air Traffic Content and are also become a system A multimicroprocessor system for ATCRBS moned and a processing A new approach to radar plot extraction for applications Extended time radar raw video recording Large terminal maneuvering areas: Operational problems - Possible development of solutions	A82-14384 A82-14741 A82-13078 A82-14774 A82-14775 Factor Fortrol A82-14777 A82-14777 A82-14908 A82-14908 A82-14909 A82-14909 A82-14909 A82-14909
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FLITERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the King MK.50 helicopter [AD-A105211] AIR INTAKES Transcnic flows in an air inlet with large incidence and the effect of a blowing trust of air inlets Studies of air inlets at Reynolds numbers	A82-14414 e turbine N82-13109 anced N82-12065 tural N82-13139 are loss A82-15606 e Sea N82-12069 N82-13071 anic	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURPACE MISSILES Integrated Plight/Weapon Control design and evaluation AIR TRAFFIC CONTROL Fuel efficient flight profiles in an ATC flow management environment Technical/operational ATC scenarios for future navigation Some Italian research for developing new product and are management evaluation of target report extraction for Radar Beacon System A multimicroprocessor system for ATCRBS mone data processing A new approach to radar plot extraction for applications Extended time radar raw video recording Large terminal manenvering areas: Operational problems - Possible development of solutions Computer-animated predictive displays for	A82-14384 A82-14741 A82-14774 A82-14774 A82-14775 Factor Control A82-14777 A82-14777 ATC A82-14908
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the King MK.50 helicopter [AD-A105211] AIR INTAKES Transcnic flows in an air inlet with large incidence and the effect of a blowing trusted and analysis system for dynatests of air inlets Studies of air inlets at Reynolds numbers comparable to flight in CHERA's F1 and Stunnels Airframe-propulsion system aerodynamic	A82-14414 eturbine N82-13109 anced N82-12065 tural N82-13139 are loss A82-15606 e Sea N82-12069 N82-13071 anic N82-13082 SHA Wind N82-13091	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURPACE MISSILES Integrated Plight/Weapon Control design and evaluation AIR TRAPPIC CONTEOL Puel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for futuravigation Some Italian research for developing new processor and attended the monopulse ATCRBS Air Traffic Content and a multimicroprocessor system A multimicroprocessor system for ATCRBS moned at a processing A new approach to radar plot extraction for applications Extended time radar raw wideo recording Large terminal maneuvering areas: Operations problems - Possible development of solution Computer-animated predictive displays for microwave landing approaches	A82-14384 A82-14741 A82-14741 A82-13078 A82-14774 A82-14775 Factor Control A82-14776 A82-14777 ATC A82-14908 A82-14908 A82-14909 A82-14909 A82-15625
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FICON Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the King MK.50 helicopter [AD-A105211] AIR INTAKES Transonic flows in an air inlet with large incidence and the effect of a blowing treatment of the stage of air inlets Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and Stunnels Airframe-propulsion system aerodynamic interference predictions at high transon	A82-14414 e turbine N82-13109 anced N82-12065 tural N82-13139 are loss A82-15606 e Sea N82-12069 ap N82-13071 anic N82-13082 sima wind N82-13091 aic Mach	AIR TO AIR BRPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SUBPACE MISSILES Integrated Plight/Weapon Control design and evaluation AIR TRAPPIC CONTROL Puel efficient flight profiles in an ATC flow management environment Technical/operational ATC scenarios for future navigation Some Italian research for developing new product and arc radars Performance evaluation of target report extraction for Radar Beacon System A multimicroprocessor system for ATCRBS mone data processing A new approach to radar plot extraction for applications Extended time radar raw video recording Large terminal maneuvering areas: Operations problems - Possible development of solutions Computer-animated predictive displays for microwave landing approaches	A82-14384 A82-14741 A82-14774 A82-14774 A82-14775 Factor Option A82-14777 A82-14777 A82-14908 A82-14909 A82-14909 A82-14909 A82-15625
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the King MK.50 helicopter [AD-A105211] AIR INTAKES Transcnic flows in an air inlet with large incidence and the effect of a blowing trusted and analysis system for dynatests of air inlets Studies of air inlets at Reynolds numbers comparable to flight in CHERA's F1 and Stunnels Airframe-propulsion system aerodynamic	A82-14414 e turbine N82-13109 anced N82-12065 tural N82-13139 are loss A82-15606 e Sea N82-12069 ap N82-13071 anic N82-13082 sima wind N82-13091 aic Mach	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURPACE MISSILES Integrated Plight/Weapon Control design and evaluation AIR TRAPPIC CONTEOL Puel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for futuravigation Some Italian research for developing new processor and attended the monopulse ATCRBS Air Traffic Content and a multimicroprocessor system A multimicroprocessor system for ATCRBS moned at a processing A new approach to radar plot extraction for applications Extended time radar raw wideo recording Large terminal maneuvering areas: Operations problems - Possible development of solution Computer-animated predictive displays for microwave landing approaches	A82-14384 A82-14741 A82-14774 A82-14774 A82-14775 Factor Option A82-14777 A82-14777 A82-14908 A82-14909 A82-14909 A82-14909 A82-15625
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the King MK.50 helicopter [AD-A105211] AIR INTAKES Transcnic flows in an air inlet with large incidence and the effect of a blowing trusted and analysis system for dyn tests of air inlets Studies of air inlets at Reynolds numbers comparable to flight in CHERA's F1 and Stunnels Airframe-propulsion system aerodynamic interference predictions at high transon numbers including off-design engine airf effects	A82-14414 e turbine N82-13109 anced N82-12065 tural N82-13139 are loss A82-15606 e Sea N82-12069 ap N82-13071 anic N82-13082 sima wind N82-13091 aic Mach	AIE TO AIE BEFUELING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SUBPACE MISSILES Integrated Flight/Weapon Control design and evaluation AIE TEAPFIC CONTEOL Puel efficient flight profiles in an ATC flow management environment Technical/operational ATC scenarios for future navigation Some Italian research for developing new produce evaluation of target report extinate monopulse ATCRBS Air Traffic Content Radar Beacon System A multimicroprocessor system for ATCRBS moned at a processing A new approach to radar plot extraction for applications Extended time radar raw video recording Large terminal maneuvering areas: Operation problems - Possible development of solutions Computer-animated predictive displays for microwave landing approaches Orienting description of air traffic control the Metherlands [VTH-LB-285]	A82-14384 A82-14741 A82-14774 A82-14774 A82-14775 Factor Futrol A82-14777 A82-14777 A82-14908 A82-14908 A82-14908 A82-14908 A82-14908 A82-14908 A82-14908
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the King MK.50 helicopter [AD-A105211] AIR INTAKES Transonic flows in an air inlet with large incidence and the effect of a blowing trests of air inlets Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and Stunnels Airframe-propulsion system aerodynamic interference predictions at high transon numbers including off-design engine airf effects AIR HAVIGATION	A82-14414 eturbine N82-13109 anced N82-12065 .tural N82-13139 are loss A82-15606 ee Sea N82-12069 .82-13071 anic N82-13082 .1MA wind N82-13091 .ic Mach	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SUBPACE MISSILES Integrated Flight/Weapon Control design and evaluation AIR TRAPPIC CONTROL Puel efficient flight profiles in an ATC flow management environment Technical/operational ATC scenarios for future navigation Some Italian research for developing new product and attended to the monopulse ATCRBS Air Traffic Control Radar Beacon System A multimicroprocessor system for ATCRBS monopulated and processing A new approach to radar plot extraction for applications Extended time radar raw video recording Large terminal maneuvering areas: Operation problems - Possible development of solutions Computer-animated predictive displays for microwave landing approaches Orienting description of air traffic control the Netherlands [VIH-LR-285] Moving target Detector/Airport Surveillance	A82-14384 A82-14741 A82-14774 A82-14774 A82-14775 Factor Futrol A82-14777 A82-14777 A82-14908 A82-14908 A82-14908 A82-14908 A82-14908 A82-14908 A82-14908
The operational characteristics of turboje giving particular attention to the coole high-pressure turbine An aerodynamic design and the overall stag performance of an air-cooled axial-flow [NAL-TR-321T] AIR CUSHION LANDING SYSTEMS Experimental and analytical studies of adv air cushion landing systems [NASA-CR-3476] AIR FILTERS Raven aircraft filter-absorber agricul aircraft [AD-A098962] AIR FLOW Experimental investigation of total pressu and airflow distribution for gas turbine combustors A vapour cycle cabin cooling system for the King MK.50 helicopter [AD-A105211] AIR INTAKES Transcnic flows in an air inlet with large incidence and the effect of a blowing trusted and analysis system for dyn tests of air inlets Studies of air inlets at Reynolds numbers comparable to flight in CHERA's F1 and Stunnels Airframe-propulsion system aerodynamic interference predictions at high transon numbers including off-design engine airf effects	A82-14414 eturbine N82-13109 anced N82-12065 .tural N82-13139 are loss A82-15606 ee Sea N82-12069 .82-13071 anic N82-13082 .1MA wind N82-13091 .ic Mach	AIR TO AIR REPUBLING KC-10, flight test program management - The contractor's viewpoint [AIAA PAPER 81-2380] AIR TO SURPACE MISSILES Integrated Flight/Weapon Control design and evaluation AIR TRAFFIC CONTROL Fuel efficient flight profiles in an ATC flomanagement environment Technical/operational ATC scenarios for future navigation Some Italian research for developing new processor and the monopulse ATCRBS Air Traffic Control Radar Beacon System A multimicroprocessor system for ATCRBS monedata processing A new approach to radar plot extraction for applications Extended time radar raw video recording Large terminal maneuvering areas: Operations problems - Possible development of solution Computer-animated predictive displays for microwave landing approaches Orienting description of air traffic control the Netherlands [VTH-LR-285] Moving target Detector/Airport Surveillance (ASE-7) field evaluation	A82-14384 A82-14741 A82-14774 A82-14774 A82-14775 Factor Futrol A82-14777 A82-14777 A82-14908 A82-14908 A82-14908 A82-14908 A82-14908 A82-14908 A82-14908

AIR TRANSPORTATION SUBJECT INDEX

AIR TRANSPORTATION	Lockheed Airborne Data System - Distributed
Transportation systems evaluation methodology	microcomputers provide on-board real-time analysis
development and applications, phase 3	[AIAA PAPER 81-2367] A82-13949
[NASA-CR-164999] N82-12051	NAECCN 1981; Froceedings of the National Aerospace
AIRBORNE BQUIPMENT On-board communication for active-control	and Electronics Conference, Dayton, OH, Hay 19-21, 1981. Volumes 1, 2 & 3
transport aircraft	19-21, 1961. VOLUMES 1, 2 6 5
[AIAA 81-2321] A82-13520	Computational considerations for fusion in target
Detection range analysis of an airborne medium PRF	identification systems multisensor correlation
radar	A82-14735
A82-14723	Software considerations in the design of computer
Airborne Electronic Terrain Map System	generated flight displays
182-14771	A 82-14742
Airborne Blectronic Terrain Map System. II -	The influence of smart computers on the cockpit of
Applications A82-14773	the future A82-14743
Commercial airborne weather radar technology	Algorithms for an adaptive dynamic window in
A82-14868	electronic map systems
High voltage/high power for airborne applications	A82-14769
A82-15918	Alrborne Electronic Map Systems. I - Design
AIRBORNE SURVEILLANCE RADAR	A82-14770
Air-to-ground MTI radar using a displaced phase	Flight management systems for modern jet aircraft
center, phased array	A82-14778
A82-14881	Design of direct digital flight-mode control
AIRBORNE/SPACEBORNE COMPUTIES Fuel efficient flight profiles in an ATC flow	systems for high-performance aircraft A82-14829
management environment	AIRCRAFT
A82-13078	Computer-animated predictive displays for
Integrated avionics - Concepts and concerns	microwave landing approaches
[AIAA 81-2211] A82-13452	A82-15816
F/A-18A weapon system - 1976 state of the art	The impact of new guidance and control systems on
[AIAA 81-2215] A82-13453	military aircraft cockpit design
Digital avionics - What a pilot expects to see	[AGARD-CP-312] N82-13048
[AIAA 81-2217] A82-13455	Prediction of aerodynamic loads on aircrafts with
Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond	external stores at transonic speeds N82-13813
[AIAA 81-2218] A82-13456	AIRCRAFT ACCIDENT INVESTIGATION
The role of avionics in the all electric airplane	Extended time radar raw video recording
[AIAA 81-2219] A82-13457	A82-14909
Computer-in-control selection logic for a triplex	A matter of seconds - A critical account of three
digital flight control system	notable air disasters /5th Major Miller Memorial
[AIAA 81-2236] A82-13465	Lecture/
Design and analysis of a digitally controlled	A82-15597
<pre>integrated flight/fire control system [AIAA 81-2245]</pre>	Investigation of severe lightning strike incidents to two USAF F+106A aircraft
Joint Tactical Microwave Landing System /JTMLS/	[NASA-CR-165794] N82-12052
airborne signal processing	Summary of Pederal Aviation Administration
[AIAA 81-2247] A82-13471	responses to National Transportation Safety
LHX - An advanced avionics system design	Board safety recommendations
[AIAA 81-2249] A82-13472	[AD-A104922] N82-12055
The SIFT computer and its development Software	AIRCRAFT ACCIDENTS
Implemented Fault Tolerance for aircraft control [AIAA 81-2278] A82-13490	HASEP - Survival from crashed Navy helicopters A82-14977
[AIAA 81-2278] A82-13490 The electronic terrain map - A new avionics	Post ejection survival
integrator	A82-14981
[AIAA 81-2289] A82-13498	A matter of seconds - A critical account of three
An update of an integrated CNI system - TIES	notable air disasters /5th Major Miller Memorial
Communication, Navigation, and Identification	Lecture/
provided by Tactical Information Exchange System	A82-15597
[AIAA 81-2292] A82-13500	AIRCRAFT ANTRUNAS
Digital avionics display processor [AIAA 81-2311] A&2-13513	Study of the effects of maneuver compensation on heam pointing accuracy
Advanced display systems for crew stations of	182-14780
tactical aircraft	AIRCRAFT APPROACH SPACING
[AIAA 81-2312] A82-13514	Alrcraft separation assurance avionics
An advanced programmable/reconfigurable color	[AIAA 81-2239] A82-13467
graphics display system for crew station	Large terminal maneuvering areas: Operational
technology research	problems - Possible development of solutions
[AIAA 81-2314] A82-13516 Higher order Information Transfer Systems are coming	AIRCRAFT CARRIERS
[AIAA 81-2317] A82-13517	Commentary on facilities used in the development
Advanced wearon systems - Integration technology	of a Sea Harrier all weather operations capability
Digital Avionic Information System	[AIAA FAPEE 81-2407] A82-13892
[AIAA 81-2213] A82-13533	The Navy F/A-18A Hornet electromagnetic
Flight experience with a remotely augmented	compatibility program
vehicle flight test technique	A82-14760
[AIAA PAPEE 81-2417] A82-13857 The need for, and development of, a simulation	AIRCRAFT COMMUNICATION ARING #29 digital data communications on the
facility at the Naval Air Test Center	ARINC 429 digital data communications on the Boeing 757 and 767 commercial airliners
[AIAA PAPER 81-2488] A82-13917	[AIAA 81-2267] A82-13485
The development and flight test evaluation of an	An update of an integrated CNI system - TIES
integrated propulsion control system for the	Communication, Navigation, and Identification
Himat research airplane	provided by Tactical Information Exchange System
[AIAA PAPEE 81-2467] A82-13931	[AIAA 81-2292] A82-13500
The development and use of a computer-interactive	On-toard communication for active-control
data acquisition and display system in a flignt environment	transport aircraft
[AIAA PAPEE 81-2371] A82-13946	[AIAA 81-2321] A82-13520 Puture directions in CNI integrated avionics
	A82-14720

SUBJECT INDEX AIRCRAFT BEGINES

mbo agilo trangroposi filtos la flavible	hoilding	Pired onin centrallar decign for ningraft	
The agile transversal filter - A flexible block for ICNIA Integrated Communica			N82-12081
Navigation and Identification Avionics	A82-14765	A standard control display unit for multi-a application	ircraft
AIRCRAFT COMPARIMENTS			N82-13054
A vapour cycle cabin cooling system for th	e Sea	AIRCRAFT DESIGN	-L
King MK-50 helicopter [AD-A105211]	N82-12069	The application of large screen CRT's, touc panels, and voice to the flight stations	
AIRCHAPT COMPIGURATIONS	202 1200	1990's	
The Agusta A129		[AIAA 81-2263]	A82-13482
mbo P-16/70 toot brosses	A82-13237	Light-guided information distribution syste	ems A82-13519
The P-16/79 test program [AIAA PAPER 81-2414]	A82-13855	[AIAA 81-2320] Thunderstorm hazards flight research - Prog	
Navy performance modeling techniques	102 10000	OVERVIEW	,
[AIAA PAPER 81-2431]	A82-13869	[AIAA PAPER 81-2412]	A82-13853
The Cessna T303 Crusader	100-10076	BiMAT aerodynamic design and flight test ex	xperience A82-13871
[AIAA PAPEE 81-2440] Evaluation of an experimental technique to	A82-13876	[AIAA PAPER 81-2433] The Cessna T303 Crusader	A02-13071
investigate the effects of the engine po		[AIAA FAPER 81-2440]	A82-13876
on engine/pylon/wing interference		Pleet Flight Loads Survey monitoring and an	aalysis
Wich magazingh in simplet annual sing	N82-13090	techniques	A82-13903
NASA research in aircraft propulsion [NASA-TH-82771]	N82-13146	[AIAA PAPER 81-2461] Powered-lift STOL aircraft shipboard operat	
AIRCRAFT CONSTRUCTION MATERIALS		A comparison of simulation, land-based an	
Impedance modeling of acoustic absorbing m	aterials	trial results for the QSBA Quiet Shor	rt-haul
for aircraft engine applications	102-10002	Research Aircraft	A82-13938
AIRCRAPT CONTROL	A82-14043	[AIAA FAPER 81-2480] Plight test concept evolution	M02-13930
Darboux points in minimum-fuel aircraft la	nding	[AIAA PAPEE 81-2375]	A82-13944
problems		Trim tab excitation system for the BAe 146	
	A82-13077	COM 2 to St. Barrer to the North	A82-14363
Digital redesign of existing multilocp con control systems with application to		62% manned aircraft demonstrator - Next ger trainer cost effective pilot trainer	
aircraft flight controller	11-10	[AIAA PAPER 81-2519]	A82-14385
-	A82-13093	Hover tests of the XV-15 Tilt Rotor Research	ch
Digital control for flexible aircraft usin	ıg	Aircraft	- 00 4 11 00 6
reduced order models	A82-13094	[AIAA PAPER 81-2501] The use of frequency methods in rotorcraft	A82-14386
Comparison between the exact and an approx		identification	system.
feedback sclution for medium range inter		[AIAA PAPER 81-2386]	A82-14392
problems	_	Development of a comprehensive analysis for	
Tatanatai animisa Garasta ani	A82-13106	rotorcraft. II - Aircraft model, solution	Δ
Integrated avionics - Concepts and concern [AIAA 81-2211]	18 182-13452	procedure and applications	A82-14407
The interface of multifunction controls an		Wing design for light transport aircraft wi	
displays to temorrow's avionics		improved fuel economy	
[AIAA 81-2290]	A82-13499	War all alastata amatan tanbadana	A82-14416
Advanced display systems for crew stations tactical aircraft	5 OI	New all-electric-system technology electromechanical actuators for aircraft	
[AIAA 81-2312]	A82-13514	Creeriancementar decareers for director	A82-14710
Computergraphics for aircraft control		The influence of smart computers on the co	ckpit of
[AIAA 81-2313]	A82-13515	the future	102 10702
Design and flight test of a lateral-direct command augmentation system	cional	The all composite Lear Fan 2100	A82-14743
[AIAA 81-2331]	A82-13527	The dir composite near ran alou	A82-14936
Plight experience with a remotely augmente	e d	Emergency in-flight egress for general avia	ation
vehicle flight test technique	.00 43057	alicraft	100 40053
[AIAA PAPER 81-2417] Plight test experience with high-alpha cor	A82-13857	A new safety harness for mobile aircrew	A82-14953
system techniques on the F-14 airplane	icioi	a new safety narpess for mobile differen	A82-14963
[AIAA PAPES 81-2505]	A82-13906	Crashworthy military passenger seat develo	pment
A unique integrated flight testing facilit	ty for		A82-14976
advanced control/display research [AIAA PAPEE 81-2490]	A82-13919	Index of National Aviation Facilities Experocement technical reports 1972 - 1977	rimentai
62% manned aircraft demonstrator - Next qu		[AD-A104759]	N82-12056
trainer cost effective pilot trainer		Computational methods of robust controller	
[AIAA PAPEE 81-2519]	A82-14385	for aerodynamic flutter suppression	
Electromechanical actuation develorment pr		[NASA-CR-164983]	N82-12080
Will power-by-wire replace power-by-hydrau	A82-14705	Research and Technology [NASA-TM-83221]	N82-13043
will bower-pl-site tebtace bower-pl-plorer	A82-14707	The impact of new quidance and control sys	
The all electric airplane - Its developmen	nt and	mılitary aircraft cockpit design	
logistic support		[AGARD-CP-312]	N82-13048
Enhanced aircraft handling qualities by	A82-14709	Aerodynamics of Power Plant Installation [AGARD-CP-301]	N82-13065
longitudinal dynamics mode decoupling		The design and development of the Tornado	
longitude of manager mode decoupling	A82-14826	air ıntake	,
Direct digital design method for reconfigu			N82-13074
nultivariable control laws for the A-7D	Digitac	Evaluation of an experimental technique to	
II aircraft	A82-14828	<pre>investigate the effects of the engine po on engine/pylon/wing interference</pre>	916108
Design of direct digital flight-mode contr		kleen,	N82-13090
systems for high-performance aircraft		AIRCRAPT DETECTION	_
Dall Dambon Ichnic Clinic Co	A82-14829	Inverse SAR and its application to aircraf	t
Ball-Bartoe Jetwing flight tests	A82-14928	classification	A82-14871
Reliability analysis of the F-8 digital	HOZ 17320	AIRCRAPT BUGINES	
fly-by-wire system		Creep and aero gas turbine design	
[NASA-CR-163110]	N82-12079		A82-12987

AIRCRAFT EQUIPMENT SUBJECT INDEX

Direct digital drive actuation [AIAA 81-2298] A82-13505	Computer simulation of an advanced aircraft
Recent propulsion system flight tests at the NASA	electrical system A82-1482
Dryden Plight Research Center [AIAA PAPER 81-2438] A82-13874	Portable air driven variable speed fiber optic cable termination polisher
Plight test method for the determination of	[AD-A104797] N82-1244
reciprocating engine cooling requirements [AIAA PAPER 81-2446] A82-13878	Practical aspects of instrumentation system installation, volume 13
Aircraft abscrbers - Picmise and practice sound attenuation	[NASA-TM-84067] N82-1314 AIRCRAPT FUEL SYSTEMS
A82-14042 Impedance modeling of acoustic absorbing maternals	The use of metal finishing in aircraft fuel systems N82-1207
for aircraft engine applications A82-14043	AIRCRAPT FOELS Darboux points in minimum-fuel aircraft landing
Conceptual design of an integrated power and avionics information system	problems A82-1307
A82-14788 60 kVA ADP permanent magnet VSCP starter generator	Quality optimization and unification of aviation gasolines
system - A program overview Variable Speed Constant Prequency	AIRCEAFT GUIDANCE
A82-14789	Fuel efficient flight profiles in an ATC flow
High speed PMG containment study for VSCF system Permanent Magnet Generator for Variable	management environment A82-1307
Speed Constant Frequency applications A82-14791	Digital detection and processing of laser beacon signals for aircraft collision hazard warning
Study of the load-carrying capacity of aviation	[AIAA 81-2528] A82-1352
gas-turbine engine impellers under low-cycle loading at normal and bigh temperatures	Commentary on facilities used in the development of a Sea Harrier all weather operations capabilit
A82-15482	[AIAA PAPER 81-2407] A82-1389
The use of metal finishing in aircraft fuel systems N82-12077	Development of an MLS lateral autoland system with automatic path definition
Aerodynamics of Power Flant Installation	[ALAA FAPER 81-1751] A82-1399
[AGARD-CP-301] N82-13065 Integration of advanced exhaust nozzles	AIRCBAPT HAZARDS Wire strike protection
N82-13075 An acquisition and analysis system for dynamic	A82-1324 Assessment methodology of the lightning threat to
tests of air inlets	advanced aircraft
N82-13082 Wind tunnel test and analysis techniques using	A82-1475 Operational evaluation of thunderstorm penetration
powered simulators for civil nacelle installaticn drag assessment	test flights during project Storm Hazards '80 A82-1495
N82-13088	A criterion for determining the causes of wind
Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe	shear at Punta Raisı Airport, on the basis of statistıcal data from barograph records A82-1546
configurations, using a full span model with turbine powered engine simulators	Investigation of severe lightning strike incidents to two USAF F-106A aircraft
N82-13089 Evaluation of an experimental technique to	[NASA-CE-165794] N82-1205 AIRCRAFT HYDRAULIC SYSTEMS
investigate the effects of the engine position on engine/pylcn/wing interference	Will power-by-wire replace power-by-hydraulics A82-1470
N82-13090 Thrust modulation methods for a subscnic V/STOL	Efficient use of working fluids in aviation hydraulic systems
aircraft	A82-1572
[NASA-TM-82747] N82-13112 A real time Pegasus propulsion system model for	AIRCRAPT INDUSTRY Advantages and limitations of various materials
VSTOL piloted simulation evaluation [NASA-TM-82770] N82-13144	used in the construction of modules aircraft construction
Sensor failure detection system for the P100	[SNIAS-812-551-103] N82-1207
turbofan engine [NASA-CR-165515] N82-13145	AIRCRAPT INSTRUMENTS Options for GTE precision automated tracking system
AIRCHAFT EQUIPMENT The Aqusta A129	airborne laser tracking system A82-1302
A82-13237 The development and use of a computer-interactive	Helicopter IFR - Past, present and future and future A82-1324
data acquisition and display system in a flight environment	Electronic flight deck displays for transport aircraft
[AIAA PAPER 81-2371] A82-13946	[AIAA 81-2264] A82-1348
Fighters - Improving the breed A82-14354	Redundancy management of skewed and dispersed inertial sensors
Pave Mover Flight Test Program [AIAA PAPEE 81-2492] A82-14380	[AIAA 81-2296] Development and laboratory test of an integrated
The all electric airplane - Its development and	sensory system /ISS/ for advanced aircraft
logistic support	[AIAA 81-2297] A82-1350
New all-electric-system technology	Flat panel developments for future mulitary aircraft [AIAA 81-2302] A82-1350
electromechanical actuators for aircraft A82-14710	An integrated control panel utilizing a programmable varistor-multiplexed dichroic
A modular multiplexed digital voice	liquid crystal display
intercommunications system A82-14721	[AIAA 81-2303] A82-1350
Computer modeling of an aircraft HVDC electrical	Digital avionics display processor [AIAA 81-2311] A82-135
system A82-14819	A Loran-C prototype navigation receiver for general aviation
Digital simulation of aircraft electrical	[AIAA 81-2329] A82-1353
generating system by means of Sceptre program 182-14820	Georgia Tech coherent jammer flight test [AIAA PAPER 81-2452] A82-1389
HO2-14020	[MAZ 136:

SUBJECT INDEX

Collection and simulation of spatial infrared	Jet V/STOL wind-tunnel simulation and groundplane
signatures of military jet aircraft [AIAA PAPEE 81-2494] A82-13921	effects A82-13973
The Advanced Range Instrumentation Aircraft	The use of frequency methods in rotorcraft system
improvement and modernization program [AIAA PAPEE 81-2368] A82-13948	identification
[AIAA PAPEE 81-2368] A82-13948 Lockheed Airborne Data System - Distributed	[AIAA PAPER 81-2386] A82-14392 Development of a comprehensive analysis for
microcomputers provide on-board real-time analysis	rotorcraft. II - Aircraft model, solution
[AIAA PAPEE 81-2367] A82-13949	procedure and applications
Index of National Aviation Facilities Experimental Center technical reports 1972 - 1977	A recursive time domain analysis of distributed
[AD-A104759] 882-12056	line grid networks with application to the
Electronic Master Mcnitor and Advisory Display	LTA/EMP problem Lightning Threat Analysis
System (PMMADS)	A82-14761
[AD-A105082] N82-12067 AIRCHAFT LANDING	Wind tunnel test and analysis techniques using powered simulators for civil nacelle
Darboux points in minimum-fuel aircraft landing	installation drag assessment
problems	N82-13088
A82-13077 Joint Tactical Microwave Landing System /JTMLS/	Establishment of an experimental technique to provide accurate measurement of the installed
airborne signal processing	drag of close coupled civil nacelle/airframe
[AIAA 81-2247] A82-13471	configurations, using a full span model with
Applications of head-up displays in commercial transport aircraft	turbine powered engine simulators N82-13089
[AIAA 81-2300] A82-13506	AIRCRAFT MOISE
Digital signal processing on a background of	The FAA's proposed helicopter certification rules
rereflections for the international aircraft landing system	L82-13242 Costs of noise nulsance from aircraft
A82-13703	A82-13314
Comparison of low-speed handling qualities in	Aircraft absorbers - Promise and practice
ground-based and in-flight simulator tests	sound attenuation
[AIAA PAPEE 81-2478] A82-13936 AN/TPN-25 and AN/GFN-22 precision approach radars	A82-14042 An advanced facility for processing aircraft
A82-14856	dynamic test data
Plight investigations of integrated descent rate	[AIAA PAPER 81-2398] A82-14377
control systems	Research and Technology
A82-14929 The use of groundspeed, in a wind shear and the	[NASA-TM-83221] N82-13043 AIRCRAFT PARTS
flight evaluation of a radar-altimeter-based	In-flight computation of helicopter transmission
system for the measurement of groundspeed	fatigue life expenditure
[AD-A104758] N82-12060 The effect of visual information on manual	[AIAA PAPEE 81-2434] A82-13872 AIRCRAFT PERFORMANCE
approach and landing	Air-to-air ccubat analysis - Review of
[NLR-MP-80019-U] N82-12064	differential-gaming approaches
Limited evaluation of an F-14A airplane utilizing an aileron-rudder interconnect control system in	A82-13115 On matching the systems identification technique
the landing configuration	to the particular application in evaluating
[NASA-TH-81972] N82-13148	flight test data
AIRCRAFT MAINTENANCE Pault isolation methodology for the L-1011 digital	An operational model of specific range for
avionic flight centrel system	microprocessor applications in piston-prop
. [AIAA 81-2223] A82-13458	general aviation airplanes
AIRCHAFT MAMBUVERS - Performance estimation from non-steady manoeuvres	[AIAA 81-2330] A82-13526 Real-time flight management avionics software system
[AIAA PAPER 81-2424] A82-13863	[AIAA 81-2340] A82-13530
HiMAT aerodynamic design and flight test experience [AIAA PAPEE 81-2433] A82-13871	Powered-lift takeoff performance characteristics
Application of a microprocessor controlled cockpit	determined from flight test of the Quiet Short-haul Research Aircraft /QSRA/
display for enhanced rilot control of flight	[AIAA PAPER 81-2409] A82-13852
test maneuvers	The F-16/79 test program
[AIAA PAPER 81-2510] A82-13908 The development of cryogenic wind tunnels and	[AIAA FAPER 81-2414] A82-13855 A technique to determine lift and drag polars in
their application to maneuvering aircraft	flight and their application
technology	[AIAA PAPER 81-2420] A82-13859
A82-13971 Technical/operational ATC scenarios for future TMA	Performance estimation from non-steady manoeuvres [AIAA PAPER 81-2424] A82-13863
navigation	Navy performance modeling techniques
A82-14774	[AIAA PAPER 81-2431] A82-13869
Study of the effects of maneuver compensation on beam pointing accuracy	The Cessna T303 Crusader [AIAA PAPER 81-2440] A82-13876
heam pointing accoracy A82-14780	[AIAA PAPER 81-2440] A82-13876 Information technology and its impact on test and
The Maneuvering Plight Path Display - A flight	evaluation at the Naval Air Test Center
trajectory solution display concept A82-14824	[AIAA PAPER 81-2396] A82-13894
Navy spin evaluation of the A-7 airplane	The Air Force Flight Test Center - Utah Test and Training Range in the 1980's
configured with automatic maneuvering flaps	[AIAA FAPER 81-2487] A82-13916
A82-14933	Pighters - Improving the breed
Large terminal mareuvering areas: Operational problems - Possible development of solutions	A82-14354 A review of flight-to-wind tunnel drag correlation
A82-15625	[AIAA PAPER 81-2475] A82-14382
AIRCRAFT MODELS	62% manned aircraft demonstrator - Next generation
Modeling procedures for handling qualities evaluation of flexible aircraft	trainer cost effective pilot trainer [AIAA PAPEE 81-2519] A82-14385
A82-13968	AD-1 oblique wing aircraft program
Aeroelasticity matters - Some reflections on two	[AIAA PAPER 81-2354] A82-14390
decades of testing in the BASA Langley Transonic Dynamics Tunnel	Development of a comprehensive analysis for rotorcraft. II - Aircraft model, solution
A82-13969	procedure and applications
	A82-14407

AIRCRAPT PILOTS

SUBJECT INDEX

ľ	esign of direct digital flight-mode contr systems for high-performance aircraft		AIRCRAPT STABILITY Navigation for helicopters by multiple use	of
7	the X-14 - 24 years of W/STCL flight testi		inertial sensors	A82-14713
I	Ball-Bartoe Jetwing flight tests	A82-14927	The use of observers on relaxed static state aircraft	_
I	/A-18A high angle of attack/spin testing	A82-14928	F/A-18A high angle of attack/spin testing	A82-14740
ŀ	C-10 flight test program	A82-14934	Acceptance testing of the Calspan variable	A82-14934
3	The all composite lear Fan 2100	A82-14935	stability Learjet	A82-14937
F	?∕A-18 roll rate improvement program	A82-14936	AV-8B technical update - Leading edge root extension development	
1	W-8B technical update - Leading edge root	A82-14939	Direct free-flight analysis of aircraft dy	A82-14940 namics
	extension develorment	A82-14940	at high angles of attack	A82-15596
C	perational evaluation of thunderstorm pen test flights during project Storm Bazard	etration	AIRCRAFT STRUCTURES Fatigue methodology - A technical manageme system for helicopter safety and durabil	nt
I	irplane performance sensitivities to late vertical profiles		Flight testing the nonmetallic spline coup.	A82-13240
	experimental and analytical studies of adv	A82-15846	technology at the Naval Air Test Center [AIAA PAPER 81-2405]	A82-13891
•	air cushion landing systems	41004	Flight vibration optimization via conforma	
1 T DC	[NASA-CB-3476] CRAFT PILOTS	N82-12065	Mochniques for modifying sinfolls and form	A82-13975
	/A-18 'Hornet' - Cne man operability [AIA 81-2266]	A82-13484	Techniques for modifying airfoils and fair aircraft using foam and fiberglass [AIAA PAPER 81-2445]	A82-14383
3	The integration of control and display con-		The load-carrying behavior of a trapezoida.	
	for improved pilot situational awareness	A82-13972	aluminum-alloy supporting element, subje- a compressive stress, in the postbucklin-	
1	issessing pilot workload - Without disturb pilot behavior	ing	Flight trail of the Aircraft Patigue Data	A82-14418
	•	A82-14745	System (APDAS) Mk 2 prototype	_
	CRAPT PRODUCTION Leronautics in China - An AIAA report		[AD-A105270] Calculation of wing-body-nacelle interfere	N82-12066 nce in
1	A system safety program for aircraft produ	A82-13150 ction	subsonic and transonic potential flow	N82-13095
	and deployment	A82-14983	AIRCRAFT SURVIVABILITY Fighters - Improving the breed	
5	The technology of sheet-metal stamping in	the	-	A82-14354
	production of aircraft /2nd revised and edution/ Russian book	-	Measured pavement response to transient ai	rcraft
	CHAPT RELIABILITY	A82-14998	loadings	N82-13442
1	ault detection for two physically separat communicating inertial measurement units		AIRCRAFT WAKES Turbulent wake development behind streamli	ned bodies
		A82-13142	-	N82-13104
	Tire strike protection Government testing	A82-13246	AIRFOIL PROFILES Subcritical and supercritical airfoils for	given
	[AIAA PAPEB 81-2443]	A82-13877	<pre>pressure distribution German-Argentine experiment: Vertical-rot</pre>	N82-12031
	Planning a helicopter flight test program [AIAA PAPER 81-2381]	A82-13881	engine experiment: Vertical-10t	N82-12648
,)perational evaluation of the new generati jet transport aircraft	Oli OI	Wind-tunnel investigation of the effects of	
j	[AIAA PAPEE 81-2377] Progress report - CH-47 modernization prog	A82-13942 ram	tip geometry on the interaction of torsi- loads and performance for an articulated	
	Helicopter reliability and maintainability	A82-14930	helicopter rotor [NASA-TP-1926]	N82-13107
	during development and production		AIRFOILS	
	[AD-A105775] CHAPT SAPBTY	N82-13136	Techniques for modifying airfoils and fair aircraft using foam and fiberglass	ings on
1	atigue methodology - A technical manageme? system for helicopter safety and durabil	nt ity	[AIAA FAPER 81-2445] The numerical solution of incompressible t	A82-14383 urbulent
1	?iber-optic immunity to EMI/EMP for milita	A82-13240	flow over airfoils	N82-12030
	aircraft	_	AIRFRAME MATERIALS	
:	[AIAA 81-2339] Safety of helicopters in flight Hussia		Advantages and limitations of various mate used in the construction of modules	
,	J.S. Navy life support development trends	A82-14946	CONSTRUCTION [SNIAS-812-551-103]	N82-12072
1	A system safety program for aircraft produ and deployment		AIRPRAMES The Navy P/A-18A Hornet electromagnetic compatibility program	
1	An analysis of civil aviation propeller-to	182-14983 -person	The role and implementation of different	A82-14760
•	accidents: 1965-1979	_	nacelle/engine simulation concepts for	longent
([AD-A105365] Computer Air Carrier Symposium	N82-12053	wind-tunnel testing in research and deve work on transport aircraft	robment
	[AD-A104894] Summary of Pederal Aviation Administration	N82-12054		N82-13086
•	responses to National Transportation Saf		Establishment of an experimental technique provide accurate measurement of the inst	alled
	Board safety recommendations [AD-A104922]	N82-12055	drag of close coupled civil nacelle/airf configurations, using a full span model	
	•	- 22 000	turbine powered engine simulators	N82-13089

SUBJECT INDEX

ATTACK AIRCEAPT

Airframe-propulsion system aerodynamic		ANTENNA ABRAYS	
interference predictions at high transon numbers including off-design engine airf.		Study of the effects of maneuver compensat.	ion on
effects	100	beam pointing accuracy	A82-14780
	N82-13098	ARTIPRICTION BEARINGS	
AIRLIBE OPERATIONS Civil aviation in China		Optimization of requirements on the	+
CIVII AVIACION IN CUINA	A82-13600	pitting-prevention properties of turboje oils	t-engine
The payoff from U.S. investment in aeronau	tical		A82-15723
research and development	A82-14793	ANTISUBMARINE WARPARE	
Analysis of integrated fuel-efficient, low-		Light Airborne Multi-Purpose System	A82-13244
procedures in terminal-area operations		APPROACH	
[DE81-029833] AIRPORT PLANNING	N82-13014	The use of groundspeed, in a wind shear an flight evaluation of a radar-altimeter-b	
Analysis of integrated fuel-efficient, low	-noise	system for the measurement of groundspee	
procedures in terminal-area operations		[AD-A104758]	N82-12060
[DE81-029833] AIRPORTS	N82-13014	The effect of visual information on manual approach and landing	
Costs of noise nuisance from aircraft		[NLR-MP-80019-U]	N82-12064
A mortistic for the state of th	A82-13314	APPROACH AND LANDING TESTS (STS)	
A criterion for determining the causes of shear at Punta Raisi Airport, on the bas		Analysis of a longitudinal pilot-induced oscillation experienced on the approach	and
statistical data from barograph records	25 02	landing test of the space shuttle	unu
1700000	A82-15468	[NASA-TH-81366]	N82-13149
AIRSPACE Large terminal maneuvering areas: Operation	nal	APPROACH CONTROL Comparison of low-speed handling qualities	in
problems - Possible development of solut		ground-based and in-flight simulator tes	
A T DC DDDD	A82-15625	[AIAA PAPER 81-2478]	A82-13936
AIRSPEED AFFTC standard airspeed calibration proced	ures	Development of an MLS lateral autoland sys automatic path definition	tem with
[AD-A104830]	N82-12074	[AIAA PAPER 81-1751]	A82-13993
ALGORITHMS Development of an MLS lateral autoland sys	tom with	APPROACH INDICATORS	nnno1
automatic path definition	tem with	Experimental evaluation of a perspective t display for three-dimensional helicopter	
[AIAA PAPER 81-1751]	A82-13993	approaches	
ALKALI HALIDES .Fire extinguishant materials		APPECKINATION	A82-15847
[NASA-CASE-ARC-11252-1]	N82-12168	Structural dynamics: Modified calculation	s
ALKALI METALS		natural and harmonically excited vibrati	
<pre>Pire extinguishant materials [NASA-CASE-ARC-11252-1]</pre>	N82-12168	modified structures; increased computati efficiency	OD
ALL-WEATHER AIR HAVIGATION		[BMVG-FBWT-81-1]	N82-13457
Commentary on facilities used in the developed of a Sea Harrier all weather operations		ARCHITECTURE (COMPUTERS)	1
	A82-13892	An advanced programmable/reconfigurable co graphics display system for crew station	
ALUMINUM ALLOYS		technology research	
The load-carrying behavior of a trapezoida aluminum-alloy supporting element, subje-		[AIAA 81-2314] Advanced weapon systems - Integration tech	A82-13516
a compressive stress, in the postbuckling		Digital Avionic Information System	rorogy
NATURAL CONTOURNS	A82-14418	[AIAA 81-2213]	№82-13533
ALUMINUM COMPOUNDS The protection of gas turbine blades - A p.	latinum	Advanced integrated CNI architectures Communications, Navigation and Identific	ation
aluminide diffusion coating		avionics for tactical aircraft and attac	
Paro ovtingnichant materials	A82-14364	helicopter	A82-14763
Fire extinguishant materials [NASA-CASE-ARC-11252-1]	N82-12168	ARGESTINA	MOZ-14703
AWALOGIES		German-Argentine experiment: Vertical-rot	or wind
Calculation of wing-body-nacelle interfere	nce in	engine	N82-12648
subsonic and transcnic potential flow	N82-13095	ATHOSPHERIC EFFECTS	802-12040
ABALYSIS (MATHRHATICS)		Updated station deselection procedures to	support
Prediction of aerodynamic loads on aircraf external stores at transcric speeds	ts Vith	automatic Omega receiver operation	A82-14712
	N82-13813	ATMOSPHERIC BLECTRICITY	202 11112
ANGLE OF ATTACK	nongo en	Direct strike lightning measurement system	for
A large-scale investigation of engine infl inlet performance at angle-of-attack	лепсе оп	aircraft [AIAA PAPER 81-2513]	A82-13910
[AIAA PAPEE 81-2481]	A82-13939	ATMOSPHERIC PRESSURE	
The USAF Test Pilot School high angle of a and spin training program	ttack	A criterion for determining the causes of shear at Punta Raisi Airport, on the bas	
and spin craining program	A82-14932	statistical data from barograph records	15 01
P/A-18A high angle of attack/spin testing			A82-15468
Direct free-flight analysis of aircraft dy	182-14934 Damics	ATMOSPHERIC SCATTERING Commercial airborne weather radar technolo	a▼
at high angles of attack	202100	CORRECTEL STENDING SCREET INSEL COURSE	3482-14868
name and accept flow minuslimation and	A82-15596	ATTACK AIRCRAPT	
Force and moment, flow-visualization, and boundary-layer tests on a shuttle orbite	r model	Air-to-air combat analysis - Review of differential-gaming approaches	
at Mach 6			A82-13115
[NASA-TP-1952] A calculation method for slender wing-body	N82-13106	The TADS/FBVS 'eyes' for the AH-64 attack	helicopter A82-13239
configurations in supersonic flow at hig		Test and evaluation of improved aircrew re	
of attack nonlinear force and pitchi		systems	
moment characteristics [BMVG-FBWT-79-15]	B82-13115	Using voice control onboard combat aircraf	A82-14974 t
VREATH ARTOCIAL		one of the second second second attended	ัช82-13056
P/A-18 roll rate improvement program			

A82-14939

A new approach to modeling the cost of ownership	AVIONICS
for aircTaft systems [AD-A104434] N82-13979	Options for GTE precision automated tracking system airborne laser tracking system
ATTITUDE STABILITY	A82-1302
Selected stability and control derivatives from	The Agusta A129
the first Space Shuttle entry	A82-1323
[AIAA PAPER 81-2451] A82-13880 AUTOMATIC CONTROL	Digital Avionics Systems Conference, 4th, St.
Technical/operational ATC scenarios for future TMA	Louis, MO, November 17-19, 1981, Collection of Technical Papers
navigation	A82-1345
A82-14774	Integrated avionics - Concepts and concerns
Automatic parachute releasers for premeditated parachuting	[AYAA 81-2211] A82-1345
A82-14960	P/A-18A weapon system - 1976 state of the art [AIAA 81-2215] A82-1345
Further test results of parachutes with automatic	Digital avionics - What a pilot expects to see
inflation modulation /A.I.M./	[AIAA 81-2217] A82-1345
A82-14965 Sensor failure detection system for the F100	Applications of digital avionics to commercial
turbofan engine	transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] A82-1345
[NASA-CE-165515] N82-13145	The role of avionics in the all electric airplane
AUTOMATIC PLIGHT CONTROL	[AIAA 81-2219] A82-1345
Digital redesign of existing multilocp continuous control systems with application to YF-16	Fault isolation methodology for the L-1011 digital
aircraft flight controller	avionic flight control system [AIAA 81-2223] A82-1345
A82-13093	Avionics implications from weapon system
Digital control for flexible aircraft using	operational utility studies on Manned Air Combat
reduced order models A82-13094	Simulators [AIAA 81-2230] A82-1346
F/A-18A weapon system - 1976 state of the art	[AIAA 81-2230] Agg-1346: Alreraft separation assurance avionics
[AIAA 81-2215] A82-13453	[AIAA 81-2239] A82-1346
Application of the concept of dynamic trim control	Aircraft alerting systems standardization study
and nonlinear system inverses to automatic control of a vertical attitude takeoff and	[AIAA 81-2242] A82-13469 LHX - An advanced avionics system design
landing aircraft	[AIAA 81-2249] A82-1347
[AIAA 81-2238] A82-13466	P/A-18 'Hornet' - One man operability
Have we overlooked the pilot's role in an	[AIAA 81-2266] A82-13484
autcmated flight deck [AIAA 81-2262] A82-13481	ARINC 429 digital data communications on the Boeing 757 and 767 commercial airliners
Direct digital drive actuation	[AIAA 81-2267] A82-1348
[AIAA 81-2298] A82-13505	A polled contention multiplex system using
Higher order Information Transfer Systems are coming	MIL-STD-1553 protocol
[AIAA 81-2317] A82-13517 Electromechanical actuation development program	[AIAA 81-2271] Avionics systems simulation for the Northrop
A82-14705	F/A-18L aircraft
Integrated Flight/Wearon Control design and	[AIAA 81-2274] A82-1348
evaluation	The electronic terrain map - A new avionics
A82-14741 Parallel processing applied to digital flight	integrator [AIAA 81-2289] A82-13498
control systems - Some perspectives	The interface of multifunction controls and
182-14794	displays to tomorrow's avionics
Microprocessor flight control application study A82-14796	[AIAA 81-2290] A82-13499
A synthesis technique for highly uncertain and	Development and laboratory test of an integrated sensory system /ISS/ for advanced aircraft
interacting multivariable flight control systems	[AIAA 81-2297] A82-13504
A82-14827	An integrated control panel utilizing a
AUTOMATIC GAIN CONTROL Automatic digital gain ranging for flight test	programmable varistor-multiplexed dichroic liquid crystal display
telemetry data	[AIAA 81-2303] A82-13506
[AIAA PAPER 81-2370] A82-13947	Digital avionics display processor
AUTOMATIC LANDING CONTROL Joint Tactical Microwave Landing System /JTMLS/	[AIAA 81-2311] A82-13513
airborne signal processing	An advanced programmable/reconfigurable color qraphics display system for crew station
[AIAA 81-2247] A82-13471	technology research
Applications of head-up displays in commercial	[AIAA 81-2314] A82-13510
transport aircraft [AIAA 81-2300] A82-13506	Advanced fiber optic systems for avionics applications
Development of an MLS lateral autoland system with	[AIAA 81-2319] A82-13518
automatic path definition	Light-guided information distribution systems
[AIAA PAPER 81-1751] A82-13993	[AIAA 81-2320] A82-13519
AN/TPN-25 and AN/GFN-22 precision approach radars A82-14856	On-board communication for active-control transport aircraft
Flight investigations of integrated descent rate	[AIAA 81-2321] A82-13520
control systems	Real-time flight management avionics software system
ARROWANT DT ORS	[AIAA 81-2340] A82-13530
AUTOMATIC PILOTS The design of exact nonlinear model followers	Time-referencing of data in an asynchronous environment for fighter aircraft avionics
with application to trajectory autopilot for	[AIAA 81-2341] A82-1353
helicopter	A Loran-C prototype navigation receiver for
AUTONATIC TEST BQUIPMENT	general aviation
Information technology and its impact on test and	[AIAA 81-2329] A82-13533 Advanced weapon systems - Integration technology
evaluation at the Naval Air Test Center	Digital Avionic Information System
[AIAA PAPER 81-2396] A82-13894	[AIAA 81-2213] A82-1353
Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines turbojet	Estimation of the efficiency of radioelectronic
engines	flight navigation systems A82-1370
[AD-A105269] N82-12076	Georgia Tech coherent jammer flight test
	[AIAA FAPER 81-2452] A82-1389

BYPASS BATIO SUBJECT INDEX

F-4 Advanced Avionics Flight Test [AIAA PAPEE 81-2464]	A82-13929	В	
The Advanced Bange Instrumentation Aircraf improvement and modernization program	t	B-1 AIRCRAFT	
[AIAA PAPBE 81-2368]	A82-13948	Comparison of wind tunnel and theoretical	
NABCON 1981; Proceedings of the National A		aeroelastic predictions with flight measu	red
and Electronics Conference, Dayton, OH, 1 19-21, 1981. Volumes 1, 2 & 3			A82-14393
Navigation for helicopters by multiple use inertial sensors	A82-14676 of	B-52 AIRCRAPT Applications of covariance analysis simulat avionics flight testing	lon to
Ineltial Seneois	A82-14713		A82-14767
Puture directions in CNI integrated avionic	cs 182-14720	BACKSCATTERING Commercial airborne weather radar technolog	y
A modular multiplexed digital voice intercommunications system		BALLISTICS	A82~14868
The influence of annut computer on the con-	A82-14721	A ballistic design model for initiators for	
The influence of smart computers on the countries the future	CKPIL OI	aircraft personnel escape systems	A82~14984
	№82-14743	BEACONS	
Assessment methodology of the lightning the advanced aircraft		Digital detection and processing of laser be signals for aircraft collision hazard war	ning .
New advances in signal processing technological	A82-14759	[AIAA 81-2328] BIBLIOGRAPHIES	A82-13525
integrated CNI avionics Communication		Index of National Aviation Facilities Exper	ımental
Navigation, and Identification	- 00 4 4 7 4 0	Center technical reports 1972 - 1977	300 4005 6
Advanced integrated CNT architectures	A82-14762	[AD-A104759] Compilation of abstracts of dissertations t	N82-12056
Advanced integrated CNI architectures Communications, Navigation and Identific	ation	and research papers submitted by candidat	
avionics for tactical aircraft and attac	k	degrees, 1 October 1979 - 30 September 19	80
helicopter		[AD-A104124]	N82-13974
Mbc	A82-14763	BLADE TIPS	4.01
The agile transversal filter - A flexible block for ICNIA Integrated Communica		Experimental and analytical studies of a mo helicopter rotor in hover	ue1
Navigation and Identification Avionics	CIOLS,	[NASA-TM-81232]	N82-12042
•	A82-14765	Wind-tunnel investigation of the effects of	
Applications of covariance analysis simula	tion to	tip geometry on the interaction of torsio	nal
avionics flight testing	AE2-14767	loads and performance for an articulated helicopter rotor	
Conceptual design of an integrated power a		[NASA-TP-1926]	N82-13107
avionics information system		BODY SIZE (BIOLOGY)	
Tenlesetion Ale Bits consider Picts	182-14788	'Little people' problem /MA-2 torso harness	/ A82-14958
Implementing the CAIS executive Ligita Avionics Information System software fear		BODY-WING CONFIGURATIONS	A02-14930
for aircraft systems		The influence of closed-coupled, rear fusel	age
	A82-14814	mounted nacelles on the design of an adva	nced
A storage device for subsystem maintenance , information		bigh speed wing	N82-13092
, dirormation	A82-14817	A calculation method for slender wing-body	102 13032
-Air-to-ground MTI radar using a displaced		configurations in supersonic flow at high	
~-center, phased array		of attack nonlinear force and pitchin	g
Portable air driven variable speed fiber o	A82-14881	moment characteristics [BMVG-PBWT-79-15]	N82-13115
cable termination polisher	pcio	BOEING AIRCRAFT	
[AD-A104797]	N82-12448	Two at a time - Plight test plans for the r	ew
The impact of new guidance and control sys	tems on	Boeing airliners	A82-13941
milıtary aircraft cockpit design [AGARD-CP-312]	N82-13048	[AIAA PAPER 81-2378] Design of a crashworthy crew seat for the E	
How the helicopter cockpit designer uses d		Vertol Chinook helicopter	,
avionics			A82-14975
	N82-13049	BORING 757 AIRCRAFT	-
Electronic flight deck displays for milita transport aircraft	гу	ARINC 429 digital data communications on the Boeing 757 and 767 commercial airliners	e
011117	N82-13050	[AIAA 81-2267]	A82-13485
Integration cf controls and displays in US	Army	BORING 767 AIRCHAFT	
helicopter cockpits	N82-13053	ARINC 429 digital data communications on the Boeing 757 and 767 commercial airliners	e
A standard control display unit for multi-		[AIAA 81-2267]	A82-13485
application		BOUNDARY LAYER PLON	
	N82-13054	Porce and moment, flow-visualization, and	
Tanker avionics and aircrew complement eva	luation N82-13063	boundary-layer tests on a shuttle orbiter at Mach 6	model
Techniques for interfacing multiplex syste		[NASA-TP-1952]	N82-13106
[AD-A101457]	N82-13135	BRAKES (POR ARRESTIEG HOTION)	
Electronic master monitor and advisory dis	play	Escape systems decelerator technology	.00 47066
<pre>system test and demonstration report [AD-A105317]</pre>	N82-13141	[AIAA FAPER 81-1913] BIPASS BATIO	A82-13966
AXES OF BOTATION	802-13141	The role and implementation of different	
German-Argentine experiment: Vertical-rot	or wind	nacelle/engine simulation concepts for	
engine	v00_106#8	wind-tunnel testing in research and devel	orment
AXIAL PLOW TURBINES	882-12648	work on transport aircraft	N82-13086
An aerodynamic design and the overall stag	e	Aerodynamic aspects of a high bypass ratio	
performance of an air-cccled axial-flow	turbine	installation on a fuselage afterbody	
[NAL-TR-321T]	N 62-13109		N82-13093
AXISYMBETRIC FLOW Investigation of acoustic interactions in	iet		
thrust augmenting ejectors	J- -		
[AD-A106083]	N 82-13835		

		CHANNELS (DATA THANSMISSION)	
		A polled contention multiplex system using	
<u> </u>		MIL-STD-1553 protocol	
C-5 AIRCRAFT		[AIAA 81-2271]	A82-13487
C-5A unsurfaced taxi and off-load demonstr		Advanced fiber optic systems for avionics	
[AIAA PAPER 81-2439]	A82-13875	applications	
CALIBRATING		[AIAA 81-2319]	A82-13518
Rotor systems research aircraft /RSRA/ rot	or force	A modular multiplexed digital voice	
and moment measurement system		intercommunications system	
[AIAA PAPER 81-2516]	A82-13913		A82-14721
Improved techniques for the calibration and	ıd	Techniques for interfacing multiplex system	ıs
measurement of in-flight loads		[AD-A101457]	N82-13135
[AIAA PAPER 81-2502]	A82-13924	CHEMICAL ATTACK	
AFFTC standard airspeed calibration proced		Attack on superalloys by chemical and elect	rolytic
[AD-A104830]	N82-12074	processes	
wind tunnel test and analysis techniques w		hrocensen	A82-14365
powered simulators for civil nacelle		CHEMICAL COMPOSITION	NO2-14303
installation drag assessment		Efficient use of working fluids in aviation	
installation dray assessment	N82-13088	hydraulic systems	•
practical aspects of instrumentation syste			A82-15724
	: W		A62-15724
installation, volume 13	NOO 40440	CHIBESE PROPLES REPUBLIC	•
[NASA-TH-84067]	N82-13140	Aeronautics in China - An AIAA report I	
CAMBRAS			A82-13150
Current aerial cameras		CHIPS (BLECTRONICS)	
	№82-15655	A storage device for subsystem maintenance	
CANOPIES		information	
Purther test results of parachutes with au	tcmatic		A82-14817
inflation modulation /A.I.M./		CIRCULAR CYLINDERS	
	A82-14965	Effects of intake geometry on circular pito	t
A look at the Hoffman Triangular parachute	- The	intake performance at zero and low forwar	d speeds
first successful glidable parachute		•	N82-13070
,	A82-14966	CIVIL AVIATION	
CARGO AIRCRAFT		Public service helicopters - Is the grass of	ireener
KC-10 flight test program		on the other side of the fence	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
No to 111940 cost program	A82-14935	on the other side of the lence	A82-13238
CARTRIDGES	202 14355	Civil aviation in China	AU2 13230
Analytical and experimental characterizati	an of	CIVIL delection in China	A82-13600
the JAU-14/A cartridge actuated initiate		Drogress in coronautical research and took	
use in aircrew escape system performance		Progress in aeronautical research and techn	lology
	•	applicable to civil air transports	100 1007
evaluation	100 10005		A82-13974
	A82-14985	Computer Air Carrier Symposium	
CASCADE CONTROL		[AD-A104894]	N82-12054
Digital redesign of existing multilocp con		Summary of Federal Aviation Administration	
control systems with application to	YF-16	responses to National Transportation Safe	ety
aircraft flight controller		Board safety recommendations	
	A82-13093	[AD-A104922]	N82-12055
CATALYSTS		Group 1: Scenario design and development i	issues
pevelopment of catalytic systems for the			N82+13131
conversion of syngas to jet fuel and die	sel fuel	CLASSIFICATIONS	
		Inverse SAR and its application to aircraft	-
and higher alcohols			-
and higher alcohols [DE82-000067]	N82-12255	classification	
[DE82-000067]	N82-12255	classification	182-14871
[DE82-000067] CATHODE BAY TUBES			A82-14871
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou	ıch	CLOCES	
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations	ıch	CLOCKS Electronic master monitor and advisory disp	
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's	ch of the	CLOCKS Electronic master monitor and advisory disp system test and demonstration report	olay
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263]	s of the 182-13482	CLOCKS Electronic master monitor and advisory disp system test and demonstration report [AD-A105317]	
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transp	s of the 182-13482	CLOCKS Electronic master monitor and advisory disp system test and demonstration report [AD-A105317] COCKPITS	olay
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft	of the A82-13482	CLOCKS Electronic master monitor and advisory disposed system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an	olay
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transparcraft [AIAA 81-2264]	s of the 182-13482	CLOCKS Electronic master monitor and advisory disposes test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck	olay N82-13141
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft	ach of the A82-13482 oort A82-13483	CLOCKS Electronic master monitor and advisory disposes test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262]	olay N82-13141 A82-13481
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays	A82-13482 oort A82-13483 A82-14823	CLOCKS Electronic master monitor and advisory disposes test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CRT's, touch	olay 182-13141 182-13481
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilita	A82-13482 oort A82-13483 A82-14823	CLOCKS Electronic master monitor and advisory dispression test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations	olay 182-13141 182-13481
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays	A82-13482 PORT A82-13483 A82-14823	CLOCKS Electronic master monitor and advisory disposes system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's	N82-13141 A82-13481 ch of the
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tout panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transparreraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for militations for transparreraft transport aircraft	A82-13482 oort A82-13483 A82-14823	CLOCKS Electronic master monitor and advisory dispression test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations	olay 182-13141 182-13481
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilita	A82-13482 A82-13483 A82-14823 A82-13050	CLOCKS Electronic master monitor and advisory disposes system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's	N82-13141 A82-13481 ch of the
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for militatransport aircraft Color CRT displays for the cockpit	A82-13482 PORT A82-13483 A82-14823	CLOCKS Electronic master monitor and advisory disposes system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263]	N82-13141 A82-13481 ch of the
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitatransport aircraft Color CRT displays for the cockpit CEBTRIFUGAL COMPRESSORS	A82-13482 A82-13483 A82-14823 A82-14823 A82-13050 N82-13051	CLOCKS Electronic master monitor and advisory disposed system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled	N82-13141 A82-13481 of the A82-13482 A82-13484 cockpit
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for militatransport aircraft Color CRT displays for the cockpit	A82-13482 A82-13483 A82-13483 A82-14823 TY N82-13050 N82-13051	CLOCKS Electronic master monitor and advisory disposes system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CRT's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266]	N82-13141 A82-13481 of the A82-13482 A82-13484 cockpit
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitatransport aircraft Color CRT displays for the cockpit CEBTRIFUGAL COMPRESSORS	A82-13482 A82-13483 A82-14823 A82-14823 A82-13050 N82-13051	CLOCKS Electronic master monitor and advisory disposed system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled	N82-13141 A82-13481 of the A82-13482 A82-13484 cockpit
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitatransport aircraft Color CRT displays for the cockpit CEBTRIFUGAL COMPRESSORS	A82-13482 A82-13483 A82-13483 A82-14823 TY N82-13050 N82-13051	CLOCKS Electronic master monitor and advisory disposes test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flights	N82-13141 A82-13481 of the A82-13482 A82-13484 cockpit
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for militatransport aircraft Color CRT displays for the cockpit CENTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market	A82-13482 A82-13483 A82-14823 LTY N82-13050 N82-13051 A82-15950	CLOCKS Electronic master monitor and advisory disposals, system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flight test maneuvers	N82-13141 A82-13481 of the A82-13482 A82-13484 cockpit ight A82-13908
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for militatransport aircraft Color CRT displays for the cockpit CEMTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market	A82-13482 A82-13483 A82-14823 LTY N82-13050 N82-13051 A82-15950	CLOCKS Electronic master monitor and advisory displays system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flight maneuvers [AIAA PAPEE 81-2510]	N82-13141 A82-13481 of the A82-13482 A82-13484 cockpit ight A82-13908
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for militatransport aircraft Color CRT displays for the cockpit CEMTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market	A82-13482 A82-13483 A82-14823 A82-14823 A82-13050 N82-13051 A82-15950 on rules	CLOCKS Electronic master monitor and advisory displaystem test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CRT's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the cooking test maneurical computers on the cooking test maneuvers.	N82-13141 A82-13481 of the A82-13482 A82-13484 cockpit ight A82-13908
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitatransport aircraft Color CRT displays for the cockpit CENTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market CERTIFICATION The FAA's proposed helicopter certification The F-16/79 test program	A82-13482 A82-13483 A82-14823 A82-14823 A82-13050 N82-13051 A82-15950 on rules	CLOCKS Electronic master monitor and advisory displays system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CRT's, touc panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flitest maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the coot the future	A82-13481 of the A82-13482 A82-13484 cockpit ight A82-13908 ckpit of
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [Alian 81-2263] Electronic flight deck displays for transparcraft [Alian 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitations transport aircraft Color CRT displays for the cockpit CENTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market CERTIFICATION The FAM's proposed helicopter certification	A82-13482 A82-13483 A82-14823 A82-13050 N82-13051 A82-15950 on rules A82-13242 A82-13855	CLOCKS Electronic master monitor and advisory displaystem test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CRT's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the cooking test maneurical computers on the cooking test maneuvers.	A82-13481 of the A82-13482 A82-13484 cockpit ight A82-13908 ckpit of
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for militatransport aircraft Color CRT displays for the cockpit CEMTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market CERTIPICATION The FAA's proposed helicopter certification The P-16/79 test program [AIAA PAPEE 81-2414]	A82-13482 A82-13483 A82-14823 A82-13050 N82-13051 A82-15950 on rules A82-13242 A82-13855	CLOCKS Electronic master monitor and advisory displaystem test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flitest maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the couthe future	A82-13481 of the A82-13482 A82-13484 cockpit ight A82-13908 ckpit of A82-14743 A82-14823
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitations transport aircraft Color CRT displays for the cockpit CEBTRIFUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market CERTIFICATION The FAA's proposed helicopter certification The F-16/79 test program [AIAA PAPES 81-2414] Simulator certification methods and the vermotion simulator	A82-13482 A82-13483 A82-14823 TY N82-13050 N82-13051 A82-15950 On rules A82-13242 A82-13855 ertical	CLOCKS Electronic master monitor and advisory disposes system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CRT's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the country of the future Airborne color CRT displays The impact of new guidance and control systems.	A82-13481 of the A82-13482 A82-13484 cockpit ight A82-13908 ckpit of A82-14743 A82-14823
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitatransport aircraft Color CRT displays for the cockpit CENTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market CERTIPICATION The FAA's proposed helicopter certification The F-16/79 test program [AIAA PAPES 81-2414] Simulator certification methods and the vermotion simulator [NASA-CR-166252]	A82-13482 A82-13483 A82-14823 A82-13050 N82-13051 A82-15950 on rules A82-13242 A82-13855	CLOCKS Electronic master monitor and advisory disposals system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the country the future Airborne color CET displays The impact of new guidance and control systemilitary aircraft cockpit design	N82-13141 A82-13481 of the A82-13482 A82-13484 cockpit ight A82-13908 ckpit of A82-14743 A82-14823 tens on
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for militatransport aircraft Color CRT displays for the cockpit CEMTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market CERTIPICATION The FAA's proposed helicopter certification The F-16/79 test program [AIAA PAPES 81-2414] Simulator certification methods and the vermotion simulator [NASA-CR-166252] CESSNA AIBCRAFT	A82-13482 A82-13483 A82-14823 TY N82-13050 N82-13051 A82-15950 On rules A82-13242 A82-13855 ertical	CLOCKS Electronic master monitor and advisory displaystem test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the country of the future Airborne color CET displays The impact of new guidance and control system.	N82-13141 A82-13481 ch of the A82-13484 cockpit ight A82-13908 ckpit of A82-14743 A82-14823 teus on N82-13048
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitations transport aircraft Color CRT displays for the cockpit CEBTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market CERTIPICATION The FAA's proposed helicopter certification The F-16/79 test program [AIAA PAPES 81-2414] Simulator certification methods and the vermotion simulator [NASA-CR-166252] CESSEA AIRCRAPT The Cessia T303 Crusader	A82-13482 A82-13483 A82-14823 A82-13050 N82-13051 A82-15950 on rules A82-13242 A82-13855 entical N82-12082	CLOCKS Electronic master monitor and advisory displaystem test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] P/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flitest maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the couthe future Airborne color CET displays The impact of new guidance and control systemilitary aircraft cockpit design [AGAED-CP-312] How the helicopter cockpit designer uses displays are controlled to the sugment of the signer uses displayed the	N82-13141 A82-13481 ch of the A82-13484 cockpit ight A82-13908 ckpit of A82-14743 A82-14823 teus on N82-13048
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitations transport aircraft Color CRT displays for the cockpit CENTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market CERTIFICATION The FAA's proposed helicopter certification The F-16/79 test program [AIAA PAPES 81-2414] Simulator certification methods and the vermotion simulator [NASA-CR-166252] CESSRA AIRCRAFT The Cessna T303 Crusader [AIAA PAPEE 81-2440]	A82-13482 A82-13483 A82-14823 TY N82-13050 N82-13051 A82-15950 On rules A82-13242 A82-13855 ertical	CLOCKS Electronic master monitor and advisory displaystem test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the country of the future Airborne color CET displays The impact of new guidance and control system.	A82-13484 cockpit ight A82-13484 cockpit ight A82-14743 A82-14823 tems on
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitatransport aircraft Color CRT displays for the cockpit CENTRIFUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market CERTIFICATION The FAA's proposed helicopter certification The F-16/79 test program [AIAA PAPES 81-2414] Simulator certification methods and the vermotion simulator [NASA-CR-166252] CESSEA AIRCRAFT The Cessor T303 Crusader [AIAA PAPES 81-2440] CH-47 HELICOPIES	A82-13482 A82-13483 A82-14823 A82-13050 N82-13051 A82-15950 On rules A82-13242 A82-13855 ertical N82-12082 A82-13876	CLOCKS Electronic master monitor and advisory disposed system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the coot the future Airborne color CET displays The impact of new guidance and control system in the color captured to the future [AGAED-CP-312]] How the helicopter cockpit designer uses displaying a sylonics	N82-13141 A82-13481 of the A82-13484 cockpit ight A82-13908 ckpit of A82-14743 A82-14823 tems on N82-13048 igital N82-13049
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitations transport aircraft Color CRT displays for the cockpit CENTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market CERTIFICATION The FAA's proposed helicopter certification The F-16/79 test program [AIAA PAPES 81-2414] Simulator certification methods and the vermotion simulator [NASA-CR-166252] CESSRA AIRCRAFT The Cessna T303 Crusader [AIAA PAPEE 81-2440]	A82-13482 A82-13483 A82-14823 A82-13050 N82-13051 A82-15950 On rules A82-13242 A82-13855 Prical N82-12082 A82-13876	CLOCKS Electronic master monitor and advisory displaystem test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flitest maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the coot the future Airborne color CET displays The impact of new guidance and control system in the coot of the future are considered as a control of the future are considered as a control of the future are considered and control system. The impact of new guidance and control system.	N82-13141 A82-13481 of the A82-13484 cockpit ight A82-13908 ckpit of A82-14743 A82-14823 tems on N82-13048 igital N82-13049
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitations transport aircraft Color CRT displays for the cockpit CENTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market CERTIPICATION The FAA's proposed helicopter certification The F-16/79 test program [AIAA PAPES 81-2414] Simulator certification methods and the vermotion simulator [NASA-CR-166252] CESSBA AIRCRAFT The Cessna T303 Crusader [AIAA PAPES 81-2440] CH-47 HELICOPTER Progress report - CH-47 modernization progress	A82-13482 A82-13483 A82-13483 A82-14823 ITY N82-13050 N82-13051 A82-15950 On rules A82-13242 A82-13855 Ortical N82-12082 A82-13876	CLOCKS Electronic master monitor and advisory disposed system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the coot the future Airborne color CET displays The impact of new guidance and control system in the color captured to the future [AGAED-CP-312]] How the helicopter cockpit designer uses displaying a sylonics	A82-13481 of the A82-13482 A82-13484 cockpit ight A82-13908 ckpit of A82-14743 A82-14823 tems on N82-13048 igital
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitations transport aircraft Color CRT displays for the cockpit CENTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market CERTIFICATION The FAA's proposed helicopter certification The F-16/79 test program [AIAA PAPES 81-2414] Simulator certification methods and the vermotion simulator [NASA-CR-166252] CESSRA AIRCRAFT The Cessna T303 Crusader [AIAA PAPES 81-2440] CH-47 HELICOPIES Progress report - CH-47 modernization progression of a crashworthy crew seat for the	A82-13482 A82-13483 A82-13483 A82-14823 ITY N82-13050 N82-13051 A82-15950 On rules A82-13242 A82-13855 Ortical N82-12082 A82-13876	CLOCKS Electronic master monitor and advisory disposed system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the control influence of smart computers on the future Airborne color CET displays The impact of new guidance and control system in the process of the signal fagard of the future are cockpit design [AGABD-CP-312] How the helicopter cockpit designer uses display avionics Electronic flight deck displays for military transport aircraft	M82-13141 A82-13481 of the A82-13484 cockpit ight A82-13908 ckpit of A82-14743 A82-14823 tems on M82-13048 igital M82-13048
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitations transport aircraft Color CRT displays for the cockpit CENTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market CERTIPICATION The FAA's proposed helicopter certification The F-16/79 test program [AIAA PAPES 81-2414] Simulator certification methods and the vermotion simulator [NASA-CR-166252] CESSBA AIRCRAFT The Cessna T303 Crusader [AIAA PAPES 81-2440] CH-47 HELICOPTER Progress report - CH-47 modernization progress	A82-13482 A82-13483 A82-14823 A82-13050 N82-13051 A82-15950 On rules A82-13242 A82-13855 ertical N82-12082 A82-13876 JITAM A82-14930 Boeing	CLOCKS Electronic master monitor and advisory displaystem test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flitest maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the coot the future Airborne color CET displays The impact of new guidance and control system in the coot of the future are considered as a control of the future are considered as a control of the future are considered and control system. The impact of new guidance and control system.	A82-13481 ch of the A82-13484 cockpit ight A82-13484 cockpit ight A82-14743 A82-14743 A82-14743 A82-14823 tews on N82-13048 igital N82-13049 cy N82-13050
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitations transport aircraft Color CRT displays for the cockpit CENTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market CERTIFICATION The FAA's proposed helicopter certification The F-16/79 test program [AIAA PAPES 81-2414] Simulator certification methods and the vermotion simulator [NASA-CR-166252] CESSRA AIRCRAFT The Cessna T303 Crusader [AIAA PAPES 81-2440] CH-47 HELICOPIES Progress report - CH-47 modernization progression of a crashworthy crew seat for the	A82-13482 A82-13483 A82-13483 A82-14823 ITY N82-13050 N82-13051 A82-15950 On rules A82-13242 A82-13855 Ortical N82-12082 A82-13876	CLOCKS Electronic master monitor and advisory disposed system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] P/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flittest maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the country flitter flitter for the future Airborne color CET displays The impact of new guidance and control system allitary aircraft cockpit design [AGABD-CP-312] How the helicopter cockpit designer uses displayed the selection of flight deck displays for military transport aircraft Color CET displays for the cockpit	A82-13481 of the A82-13484 cockpit ight A82-13484 cockpit ight A82-13908 ckpit of A82-14743 A82-14823 tems on N82-13048 igital N82-13049 ry N82-13050
[DE82-000067] CATHODE BAY TUBES The application of large screen CRT's, tou panels, and voice to the flight stations 1990's [AIAA 81-2263] Electronic flight deck displays for transpaircraft [AIAA 81-2264] Airborne color CRT displays Electronic flight deck displays for Bilitations transport aircraft Color CRT displays for the cockpit CENTRIPUGAL COMPRESSORS CT7 - GE attacks commuter turboprop market CERTIFICATION The FAA's proposed helicopter certification The F-16/79 test program [AIAA PAPES 81-2414] Simulator certification methods and the vermotion simulator [NASA-CR-166252] CESSRA AIRCRAFT The Cessna T303 Crusader [AIAA PAPES 81-2440] CH-47 HELICOPIES Progress report - CH-47 modernization progression of a crashworthy crew seat for the	A82-13482 A82-13483 A82-14823 A82-13050 N82-13051 A82-15950 On rules A82-13242 A82-13855 ertical N82-12082 A82-13876 JITAM A82-14930 Boeing	CLOCKS Electronic master monitor and advisory disposed system test and demonstration report [AD-A105317] COCKPITS Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] The application of large screen CET's, touch panels, and voice to the flight stations 1990's [AIAA 81-2263] F/A-18 'Bornet' - One man operability [AIAA 81-2266] Application of a microprocessor controlled display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] The influence of smart computers on the control influence of smart computers on the future Airborne color CET displays The impact of new guidance and control system in the process of the signal fagard of the future are cockpit design [AGABD-CP-312] How the helicopter cockpit designer uses display avionics Electronic flight deck displays for military transport aircraft	A82-13481 of the A82-13484 cockpit ight A82-13484 cockpit ight A82-13908 ckpit of A82-14743 A82-14823 tems on N82-13048 igital N82-13049 ry N82-13050

N82-13053

SUBJECT INDEX COMPUTER PROGRAMS

P/A 18 Hornet crew station		Effect of fighter attack spectrum on compos	site
COLLAPSE	N82-13064	fatigue life [AD-A105034]	N82-12143
Theoretical analysis of wake-induced parac collapse	hute	Research and Technology [NASA-TH-83221]	N82-13043
[AIAA PAPER 81-1922]	A82-13963	COMPOSITE STRUCTURES A set of finite elements developed for the	
Head up displays	42252	computation of composite helicopter blad	
COLLISION AVOIDANCE	N82-13052	[ONERA, TP NO. 1981-87] The all composite Lear Fan 2100	A82-13990
Aircraft separation assurance avionics		The dir composite heat ran 2100	A82-14936
[AIAA 81-2239]	A82-13467	COMPRESSION LOADS	
Digital detection and processing of laser signals for aircraft collision hazard wa		The load-carrying behavior of a trapezoida: aluminum-alloy supporting element, subject	
[AIAA 81-2328] COLOR VISION	A82-13525	a compressive stress, in the postbuckling	
Alrborne color CRT displays	A82-14823	Measured pavement response to transient air	ccraft
COMBAT	802-14023	loadings	N82-13442
Air-to-air combat analysis - Review of		COMPRESSOR EFFICIENCY	_
differential-gaming approaches	A82-13115	Compressor stall inducing installation efforts	
Use of a helmet-mounted matrix display for		an engine control parameter for the CF-5	N82-1308
presenting energy-maneuverability inform		COMPUTATIONAL PLUID DYNAMICS	
during simulated close combat	N82-13061	Overview of flight and ground testing with	
COMBUSTION CHAMPERS	NOZ- 13001	emphasis on the wind tunnel	A82-13928
Experimental investigation of total pressu	re loss	The operational characteristics of turboje	
and airflow distribution for gas turbine		giving particular attention to the coole	đ
combustors	A82-15606	high-pressure turbine	A82-14414
COMBUSTION PRODUCTS	202 13000	Rapid elliptic solvers	
Chemistry of combustion of fuel-water mixt		Parada and the salary of the salary of	A82-15827
[AD-A105401] COMMAND AND CONTROL	N82-12178	Remarks on the calculation of transonic po- flow by a finite volume method	tential
Computergraphics for aircraft control		2200 Dy a 21m2cc volume meemod	A82-15835
[AIAA 81-2313]	A82-13515	Prediction and measurement of time-variant	
Using voice control onboard combat aircraf	t N82-13056	three-dimensional flows in military airc: intakes	rart
COMMAND GUIDANCE			N82-1306
A polled contention multiplex system using		COMPUTER DESIGN	
MIL-STD-1553 protoccl [AIAA 81-2271]	A82-13487	The SIFT computer and its development : Implemented Fault Tolerance for aircraft	
Design and flight test of a lateral-direct		[AIAA 81-2278]	A82-1349
command augmentation system	-00 40505	COMPUTER GRAPHICS	
[AIAA 81-2331] COMMERCIAL AIRCEAFT	A82-13527	The electronic terrain map - A new avionic: integrator	5
Applications of digital avionics to commer	cıal	[AIAA 81-2289]	A82-1349
transport aircraft - The DC-9 Super 80 a		Computergraphics for aircraft control	100 1351
[AIAA 81-2218] Applications of head-up displays in commer	A82-13456 cial	[AIAA 81-2313] An advanced programmable/reconfigurable co.	A82-13519 lor
transport aircraft		graphics display system for crew station	
[AIAA 81-2300]	A82-13506	technology research	102-1251
C17 - GE attacks commuter turboprop market	A82-15950	(AIAA 81-2314) Software considerations in the design of c	A82-1351 omputer
Application of singular perturbation theor		generated flight displays	_
In-corrige apprection methods for graphite	N82-12050	Airbarna Plastronia Man Sustana I - Docid	A82-1474
In-service inspection methods for graphite structures on commercial transport aircr		Airborne Blectronic Map Systems. I - Desig	_ ∆82-1477
[NASA-CR-165746]	N82-12142	Computer image generation for flight simul	
COMMUNICATION CABLES		Progrimontal enaluation of a perspective t	∆82-15599
Fiber-optic immunity to EBI/EMP for milita aircraft	1)	Experimental evaluation of a perspective t display for three-dimensional helicopter	
[AIAA 81-2339]	A82-13529	approaches	
COMMUNICATION EQUIPMENT Light-guided information distribution syst	0.79.5	COMPUTER NETWORKS	A82-1584
[AIAA 81-2320]	A82-13519	Low cost programmable multisimulator facul	ity
Portable air driven variable speed fiber o	ptic	[AIAA 81-2229]	∆82-1353
cable termination colisher [AD-A104797]	N82-12448	COMPUTER PROGRAMMING Mathematical programming in engineering de	sian
COMMUNICATION NETWORKS	802-12440	problems	3191
Using phased array radar for data communic			A82-1586
COMMUNICATION THEORY	∆82-14725	COMPUTER PROGRAMS The SIFT computer and its development	Software
Distributed Time Division Bultiple Access	/DTDMA/	Implemented Fault Tolerance for aircraft	
 A distributed signaling technique for 	advanced	[AIAA 81-2278]	A82-1349
tactical communications	A82-14719	Navy performance modeling techniques [AIAA PAPER 81-2431]	A82-1386
COMPONENT RELIABILITY	202 14713	The need for, and development of, a simula	
Practical aspects of instrumentation syste	ш	facility at the Naval Air Test Center	
installation, volume 13 [NASA-TM-84067]	B82-13140	[AIAA PAPER 81-2488] The design and implementation of a canned	A82-1391° scenario
COMPOSITE MATERIALS		function for the P-16 dynamic system sim	ulator
Investigation of the structural degradation			A82-1467
personnel hazards resulting from helicop composite structures exposed to fires an		Weather impact on low-altitude imaging inf sensors in Europe - An availability mode	
explosions	u, u <u>r</u>	penners in perobe un nantionistel mone	▲82-1477
[AD-A104757]	N82-12057		

Digital simulation of aircraft electrical	Computer simulation of an advanced aircraft
generating system by means of Sceptre program A82-14820	electrical system
Investigation of the structural degradation and	A synthesis technique for highly uncertain and
personnel hazards resulting from helicopter	interacting multivariable flight control systems
composite structures exposed to fires and/or	A82-14827
explosions	Performance assessment of the ACES-II ejection
[AD-A104757] N82-12057	seat-A-10 configuration
Subsonic military aircraft engine intake: An	A82-14980
integrated theoretical experiment design	Subsonic military aircraft engine intake: An
N82-13073	integrated theoretical experiment design
Numerical analysis of the scramjet-inlet flow	N82-13073
field by using two-dimensional Navier-Stokes	COMPREHEES
equations	Digital Avionics Systems Conference, 4th, St.
[NASA-TP-1940] N82-13142	Iouis, MC, November 17-19, 1981, Collection of
COMPUTER STORAGE DEVICES	Technical Papers
A storage device for subsystem maintenance	A82-13451
information	NAECCH 1981: Proceedings of the National Aerospace
A82-14817	and Electronics Conference, Dayton, OH, May
COMPUTER SYSTEMS DESIGN	19-21, 1981. Volumes 1, 2 & 3
Information technology and its impact on test and	A82-14676
evaluation at the Naval Air Test Center	The impact of new guidance and control systems on
[AIAA PAPER 81-2396] A82-13894	military aircraft cockpit design
The need for, and development of, a simulation	[AGARD-CP-312] N82-13048
facility at the Naval Air Test Center	COMPORNAL MAPPING
[AIAA PAPEE 81-2488] A82-13917	Flight vibration optimization via conformal mapping
Two at a time - Flight test plans for the new	A82-13975
Boeing airliners	CONICAL HOZZLES
[AIAA PAPER 81-2378] A82-13941	The subsonic performance of practical military
The design and implementation of a canned scenario	variable area convergent nozzles
function for the F-16 dynamic system simulator	N82-13076
A82-14678	COMTROL BOARDS
COMPUTER SYSTEMS PROGRAMS	Flat panel developments for future military aircraft
An advanced programmable/reconfigurable color	[AIAA 81-2302] A82-13507
graphics display system for crew station	An integrated control panel utilizing a
technology research	programmable varistor-multiplexed dichroic
[AIAA 81-2314] A82-13516	liquid crystal display
Real-time flight management avionics software system	[AIAA 81-2303] A82-13508
[AIAA 81-2340] A82-13530	Tanker avionics and aircrew complement evaluation
Software considerations in the design of computer	N82-13063
generated flight displays A82-14742	F/A 18 Hornet crew station N82-13064
Implementing the CAIS executive Digital	CONTROL CONFIGURED VEHICLES
Avionics Information System software feasibility	Direct digital design method for reconfigurable
for aircraft systems A82-14814	multivariable control laws for the A-7D Digitac II aircraft
for aircraft systems A82-14814 General purpose real-time interaction panel for	multivariable control laws for the A-7D Digitac
for aircraft systems A82-14814	<pre>nultivariable control laws for the A-7D Digitac II aircraft</pre>
for aircraft systems A82-14814 General purpose real-time interaction panel for digital simulation of flight control systems A82-14831	<pre>nultivariable control laws for the A-7D Digitac II aircraft A82-14828</pre>
for aircraft systems A82-14814 General purpose real-time interaction panel for digital simulation of flight control systems A82-14831 COMPUTER TECHNIQUES	multivariable control laws for the A-7D Digitac II aircraft A82-14828 CONTROL REQUIRMENT The interface of multifunction controls and displays to temorrow's avionics
for aircraft systems A82-14814 General purpose real-time interaction panel for digital simulation of flight control systems A82-14831 COMPUTER TECHNIQUES The Maneuvering Flight Path Display - A flight	nultivariable control laws for the A-7D Digitac II aircraft A82-14828 CONTROL EQUIPMENT The interface of multifunction controls and displays to temorrow's avionics [AIAA 81-2290] A82-13499
for aircraft systems A82-14814 General purpose real-time interaction panel for digital simulation of flight control systems A82-14831 COMPUTER TECHNIQUES The Maneuvering Flight Path Display - A flight trajectory solution display concept	multivariable control laws for the A-7D Digitac II aircraft A82-14828 CONTROL EQUIPMENT The interface of multifunction controls and displays to temorrow's avionics [AIAA 81-2290] The use of separated multifunction inertial
for aircraft systems A82-14814 General purpose real-time interaction panel for digital simulation of flight control systems A82-14831 COMPUTER TECHNIQUES The Maneuvering Flight Path Display - A flight trajectory solution display concept A82-14824	multivariable control laws for the A-7D Digitac II aircraft A82-14828 CONTROL EQUIPMENT The interface of multifunction controls and displays to temorrow's avionics [AIAA 81-2290] The use of separated multifunction inertial sensors for flight control
for aircraft systems A82-14814 General purpose real-time interaction panel for digital simulation of flight control systems A82-14831 COMPUTER TECHBIQUES The Maneuvering Flight Fath Display - A flight trajectory solution display concept A82-14824 Computer-animated predictive displays for	multivariable control laws for the A-7D Digitac II aircraft A82-14828 CONTROL EQUIPMENT The interface of multifunction controls and displays to temorrow's avionics [AIAA 81-2290] The use of separated multifunction inertial sensors for flight control [AIAA 81-2295] A82-13502
for aircraft systems A82-14814 General purpose real-time interaction panel for digital simulation of flight control systems A82-14831 COMPUTER TECHNIQUES The Maneuvering Flight Fath Display - A flight trajectory solution display concept A82-14824 Computer-animated predictive displays for microwave landing approaches	multivariable control laws for the A-7D Digitac II aircraft A82-14828 CONTROL EQUIPMENT The interface of multifunction controls and displays to temorrow's avionics [AIAA 81-2290] The use of separated multifunction inertial sensors for flight control [AIAA 81-2295] A82-13502 The integration of control and display concepts
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for aircraft systems A82-14814 General purpose real-time interaction panel for digital simulation of flight control systems A82-14831 COMPUTER TECHBIQUES The Maneuvering Plight Path Display - A flight trajectory solution display concept A82-14824 Computer-animated predictive displays for microwave landing approaches A82-15816 Compilation of abstracts of dissertations theses, and research papers submitted by candidates for degrees, 1 October 1979 - 30 September 1980 [AD-A104124] COMPUTERIZED DESIGN Digital redesign of existing multilocp continuous control systems with application to YF-16 aircraft flight controller A82-13093 High voltage/high power for airborne applications A82-15918 Subcritical and supercritical airfoils for given pressure distribution N82-12031 COMPUTERIZED SINULATION Low cost programmable multisimulator facility [AIAA 81-2229] Navy performance modeling techniques [AIAA PAPER 81-2431] The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] A82-13917 Strapdown inertial reference systems performance	The integration of control and display concepts for improved pilot situational awareness The impact of new guidance and control systems on military aircraft cockpit design [AGARD-CP-312] Integration of controls and displays in US Army helicopter cockpits A standard control display unit for multi-aircraft application [NASA-CR-165515] Sensor failure detection system for the P100 turbofan engine [NASA-CR-165515] A vionics systems simulation for the Northrop P/A-18L aircraft [AINA 81-2274] Modeling procedures for handling qualities evaluation of flexible aircraft
General purpose real-time interaction panel for digital simulation of flight control systems A82-14831 COMPUTER TECHNIQUES The Maneuvering Flight Path Display - A flight trajectory solution display concept A82-14824 Computer-animated predictive displays for microwave landing approaches A82-15816 Compilation of abstracts of dissertations theses, and research papers submitted by candidates for degrees, 1 October 1979 - 30 September 1980 [AD-A104124] COMPUTENIZED DESIGN Digital redesign of existing multilocy continuous control systems with application to YF-16 aircraft flight controller A82-13093 High voltage/high power for airborne applications A82-15918 Subcritical and supercritical airfoils for given pressure distribution N82-12031 COMPUTENIZED SIBULATION Low cost programmable multisimulator facility [AIAA 81-2229] Navy performance modeling techniques [AIAA PAPER 81-2431] The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] Strapdown inertial reference systems performance	CONTROL EQUIFMENT The interface of multifunction controls and displays to temorrow's avionics [AIAA 81-2290] The use of separated multifunction inertial sensors for flight control [AIAA 81-2295] The integration of control and display concepts for improved pilot situational awareness A82-13972 The impact of new guidance and control systems on military aircraft cockpit design [AGARD-CP-312] Integration of controls and displays in US Army helicopter cockpits A standard control display unit for multi-aircraft application Sensor failure detection system for the P100 turbofan engine [NASA-CR-165515] CONTROL SIMULATION An approach to robust nonlinear control design with illustration of J-85 turbojet engine simulation A82-13128 Avionics systems simulation for the Northrop P/A-181 aircraft [AIAA 81-2274] Modeling procedures for handling qualities evaluation of flexible aircraft
for aircraft systems A82-14814 General purpose real-time interaction panel for digital simulation of flight control systems A82-14831 COMPUTER TECHNIQUES The Maneuvering Flight Path Display - A flight trajectory solution display concept A82-14824 Computer-animated predictive displays for microwave landing approaches A82-15816 Compilation of abstracts of dissertations theses, and research papers submitted by candidates for degrees, 1 october 1979 - 30 September 1980 [AD-A104124] COMPUTERIZED DESIGN Digital redesign of existing multilocy continuous control systems with application to YF-16 aircraft flight controller A82-13093 High voltage/high power for airborne applications A82-15918 Subcritical and supercritical airfoils for given pressure distribution N82-12031 COMPUTERIZED SINULATION Low cost programmable multisimulator facility [AIAA 81-2229] Navy performance modeling techniques [AIAA PAPER 81-2431] A82-13869 The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] Strapdown inertial reference systems performance analysis	The impact of new guidance and control systems on military aircraft cockpit design [AGARD-CP-312] N82-13048 Integration of controls and displays to to morrow's avionics [AIAA 81-2295] A82-13502 The use of separated multifunction inertial sensors for flight control [AIAA 81-2295] A82-13502 The integration of control and display concepts for improved pilot situational awareness A82-13972 The impact of new guidance and control systems on military aircraft cockpit design [AGARD-CP-312] N82-13048 Integration of controls and displays in US Army helicopter cockpits N82-13053 A standard control display unit for multi-aircraft application N82-13054 Sensor failure detection system for the P100 turbofan engine [NASA-CR-165515] N82-13145 COMTROL SIMULATION An approach to robust nonlinear control design with illustration of J-85 turbojet engine simulation A82-13128 Avionics systems simulation for the Northrop P/A-18L aircraft [AIAA 81-2274] A82-13488 Modeling procedures for handling qualities evaluation of flexible aircraft [AIAA 81-2274] Modeling procedures for handling qualities evaluation of flexible aircraft
General purpose real-time interaction panel for digital simulation of flight control systems A82-14831 COMPUTER TECHNIQUES The Maneuvering Flight Path Display - A flight trajectory solution display concept A82-14824 Computer-animated predictive displays for microwave landing approaches A82-15816 Compilation of abstracts of dissertations theses, and research papers submitted by candidates for degrees, 1 October 1979 - 30 September 1980 [AD-A104124] COMPUTENIZED DESIGN Digital redesign of existing multilocy continuous control systems with application to YF-16 aircraft flight controller A82-13093 High voltage/high power for airborne applications A82-15918 Subcritical and supercritical airfoils for given pressure distribution N82-12031 COMPUTENIZED SIBULATION Low cost programmable multisimulator facility [AIAA 81-2229] Navy performance modeling techniques [AIAA PAPER 81-2431] The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] Strapdown inertial reference systems performance	CONTROL EQUIFMENT The interface of multifunction controls and displays to temorrow's avionics [AIAA 81-2290] The use of separated multifunction inertial sensors for flight control [AIAA 81-2295] The integration of control and display concepts for improved pilot situational awareness A82-13972 The impact of new guidance and control systems on military aircraft cockpit design [AGARD-CP-312] Integration of controls and displays in US Army helicopter cockpits A standard control display unit for multi-aircraft application Sensor failure detection system for the P100 turbofan engine [NASA-CR-165515] CONTROL SIMULATION An approach to robust nonlinear control design with illustration of J-85 turbojet engine simulation A82-13128 Avionics systems simulation for the Northrop P/A-181 aircraft [AIAA 81-2274] Modeling procedures for handling qualities evaluation of flexible aircraft
for aircraft systems A82-14814 General purpose real-time interaction panel for digital simulation of flight control systems A82-14831 COMPUTER TECHBIQUES The Maneuvering Plight Path Display - A flight trajectory solution display concept A82-14824 Computer-animated predictive displays for microwave landing approaches A82-15816 Compilation of abstracts of dissertations theses, and research papers submitted by candidates for degrees, 1 October 1979 - 30 September 1980 [AD-A104124] COMPUTERIZED DESIGN Digital redesign of existing multilocp continuous control systems with application to YF-16 aircraft flight controller A82-13093 High voltage/high power for airborne applications A82-15918 Subcritical and supercritical airfoils for given pressure distribution N82-12031 COMPUTERIZED SINULATION Low cost programmable multisimulator facility [AIAA 81-2229] Navy performance modeling techniques [AIAA PAPER 81-2431] The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] Strapdown inertial reference systems performance analysis A82-14682 A methodology for missile launch envelope display	multivariable control laws for the A-7D Digitac II aircraft A82-14828 COBTROL EQUIPMENT The interface of multifunction controls and displays to tomorrow's avionics [AIAA 81-2290] The use of separated multifunction inertial sensors for flight control [AIAA 81-2295] The integration of control and display concepts for improved pilot situational awareness A82-13972 The impact of new guidance and control systems on military aircraft cockpit design [AGARD-CP-312] Integration of controls and displays in US Army helicopter cockpits A standard control display unit for multi-aircraft application Sensor failure detection system for the P100 turbofan engine [NASA-CR-165515] COMTROL SINULATION An approach to robust nonlinear control design with illustration of J-85 turbojet engine simulation AVIONICS Systems simulation for the Northrop P/A-18L aircraft [AIAA 81-2274] Modeling procedures for handling qualities evaluation of flexible aircraft A82-13968 CONTROL STABILITY The use of observers on relaxed static stability aircraft
General purpose real-time interaction panel for digital simulation of flight control systems A82-14831 COMPUTER TECHNIQUES The Maneuvering Plight Path Display - A flight trajectory solution display concept A82-14824 Computer-animated predictive displays for microwave landing approaches A82-15816 Compilation of abstracts of dissertations theses, and research papers submitted by candidates for degrees, 1 October 1979 - 30 September 1980 [AD-A104124] COMPUTERIZED DESIGN Digital redesign of existing multilocp continuous control systems with application to YF-16 aircraft flight controller Migh voltage/high power for airborne applications A82-15918 Subcritical and supercritical airfoils for given pressure distribution N82-12031 COMPUTERIZED SINULATION Low cost programmable multisimulator facility [AIAA 81-2229] Navy performance modeling techniques [AIAA PAPER 81-2431] The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] Strapdown inertial reference systems performance analysis A82-14682 A methodology for missile launch envelope display evaluation	multivariable control laws for the A-7D Digitac II aircraft A82-14828 COBTROL EQUIPMENT The interface of multifunction controls and displays to tomorrow's avionics [AIAA 81-2290] The use of separated multifunction inertial sensors for flight control [AIAA 81-2295] The integration of control and display concepts for improved pilot situational awareness A82-13972 The impact of new guidance and control systems on military aircraft cockpit design [AGARD-CP-312] Integration of controls and displays in US Army helicopter cockpits A standard control display unit for multi-aircraft application Sensor failure detection system for the P100 turbofan engine [NASA-CR-165515] COMTROL SINULATION An approach to robust nonlinear control design with illustration of J-85 turbojet engine simulation AVIONICS Systems simulation for the Northrop P/A-18L aircraft [AIAA 81-2274] Modeling procedures for handling qualities evaluation of flexible aircraft A82-13968 CONTROL STABILITY The use of observers on relaxed static stability aircraft
General purpose real-time interaction panel for digital simulation of flight centrol systems A82-14831 COMPUTER TECHNIQUES The Maneuvering Plight Path Display - A flight trajectory solution display concept A82-14824 Computer-animated predictive displays for microwave landing approaches A82-15816 Compilation of abstracts of dissertations theses, and research papers submitted by candidates for degrees, 1 October 1979 - 30 September 1980 [AD-A104124] COMPUTERIZED DESIGN Digital redesign of existing multilocp continuous control systems with application to YF-16 aircraft flight controller A82-13093 High voltage/high power for airborne applications A82-15918 Subcritical and supercritical airfoils for given pressure distribution N82-12031 COMPUTERIZED SIBULATION Low cost programmable multisimulator facility [AIAA 81-2229] Navy performance modeling techniques [AIAA PAPER 81-2431] The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] Strapdown inertial reference systems performance analysis A82-14682 A methodology for missile launch envelope display evaluation A82-14744 Computer modeling of an aircraft HVIC electrical system	multivariable control laws for the A-7D Digitac II aircraft A82-14828 CONTROL ECUIPMENT The interface of multifunction controls and displays to tomorrow's avionics [AIAA 81-2290] The use of separated multifunction inertial sensors for flight control [AIAA 81-2295] The integration of control and display concepts for improved pilot situational awareness A82-13972 The impact of new guidance and control systems on military aircraft cockpit design [AGAND-CP-312] Integration of controls and displays in US Army helicopter cockpits N82-13053 A standard control display unit for multi-aircraft application N82-13054 Sensor failure detection system for the P100 turbofan engine [NASA-CR-165515] CONTROL SINULATICN An approach to robust nonlinear control design with illustration of J-85 turbojet engine simulation A82-13128 Avionics systems simulation for the Northrop F/A-18L aircraft [AIAA 81-2274] Bodeling procedures for handling qualities evaluation of flexible aircraft A82-13968 CONTROL STABILITY The use of observers on relaxed static stability aircraft CONTROL SURPACES Direct digital design method for reconfigurable
General purpose real-time interaction panel for digital simulation of flight control systems A82-14831 COMPUTER TECHNIQUES The Maneuvering Plight Path Display - A flight trajectory solution display concept A82-14824 Computer-animated predictive displays for microwave landing approaches A82-15816 Compilation of abstracts of dissertations theses, and research papers submitted by candidates for degrees, 1 October 1979 - 30 September 1980 [AD-A104124] COMPUTENIZED DESIGN Digital redesign of existing multilocp continuous control systems with application to IP-16 aircraft flight controller A82-13093 High voltage/high power for airborne applications A82-15918 Subcritical and supercritical airfoils for given pressure distribution N82-12031 COMPUTENIZED SINULATION Low cost programmable multisimulator facility [AIAA 81-2229] Navy performance modeling techniques [AIAA PAPER 81-2481] The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2489] Strapdown inertial reference systems performance analysis A82-14682 A methodology for missile launch envelope display evaluation A82-14744 Computer modeling of an aircraft JVCC electrical	multivariable control laws for the A-7D Digitac II aircraft A82-14828 CONTROL EQUIPMENT The interface of multifunction controls and displays to tomorrow's avionics [AIAA 81-2290] The use of separated multifunction inertial sensors for flight control [AIAA 81-2295] The integration of control and display concepts for improved pilot situational awareness The impact of new guidance and control systems on military aircraft cockpit design [AGARD-CP-312] Integration of controls and displays in US Army helicopter cockpits A standard control display unit for multi-aircraft application Sensor failure detection system for the F100 turbofan engine [NASA-CR-165515] CONTROL SIMULATION An approach to robust nonlinear control design with illustration of J-85 turbojet engine simulation A82-13128 Avionics systems simulation for the Northrop F/A-18L aircraft [AIAA 81-2274] Modeling procedures for handling qualities evaluation of flexible aircraft CONTROL STABILITY The use of observers on relaxed static stability aircraft CONTROL SUBPACES Direct digital design method for reconfigurable multivariable control laws for the A-7D Digitac
General purpose real-time interaction panel for digital simulation of flight centrol systems A82-14831 COMPUTER TECHNIQUES The Maneuvering Plight Path Display - A flight trajectory solution display concept A82-14824 Computer-animated predictive displays for microwave landing approaches A82-15816 Compilation of abstracts of dissertations theses, and research papers submitted by candidates for degrees, 1 October 1979 - 30 September 1980 [AD-A104124] COMPUTERIZED DESIGN Digital redesign of existing multilocp continuous control systems with application to YF-16 aircraft flight controller A82-13093 High voltage/high power for airborne applications A82-15918 Subcritical and supercritical airfoils for given pressure distribution N82-12031 COMPUTERIZED SIBULATION Low cost programmable multisimulator facility [AIAA 81-2229] Navy performance modeling techniques [AIAA PAPER 81-2431] The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] Strapdown inertial reference systems performance analysis A82-14682 A methodology for missile launch envelope display evaluation A82-14744 Computer modeling of an aircraft HVIC electrical system	multivariable control laws for the A-7D Digitac II aircraft A82-14828 CONTROL ECUIPMENT The interface of multifunction controls and displays to tomorrow's avionics [AIAA 81-2290] The use of separated multifunction inertial sensors for flight control [AIAA 81-2295] The integration of control and display concepts for improved pilot situational awareness A82-13972 The impact of new guidance and control systems on military aircraft cockpit design [ACARD-CP-312] Integration of controls and displays in US Army helicopter cockpits N82-13053 A standard control display unit for multi-aircraft application N82-13054 Sensor failure detection system for the P100 turbofan engine [NASA-CR-165515] CONTROL SINULATICN An approach to robust nonlinear control design with illustration of J-85 turbojet engine simulation A82-13128 Avionics systems simulation for the Northrop F/A-18L aircraft [AIAA 81-2274] Bodeling procedures for handling qualities evaluation of flexible aircraft A82-13968 CONTROL STABILITY The use of observers on relaxed static stability aircraft CONTROL SURPACES Direct digital design method for reconfigurable

SUBJECT INDEX DATA MANAGEMENT

Porce and moment, flow-visualization, and	COUPLING
boundary-layer tests on a shuttle orbiter mode	Effects of aerodynamic coupling on the dynamics of
at Mach 6	roll aircraft
[NASA-TP-1952] N82-1	
Pressure distributions on three different	COUPLINGS
cruciform aft-tail control surfaces of a	Plight testing the nonmetallic spline coupling
wingless missile at Mach 1.60, 2.36, and 3.70.	
Volume 1: Trapezoidal tail [NASA-TM-8C097] N82-1	[AIAA FAPER 81-2405] A82-1389 13110 COVARIANCE
CONTROL THEORY	Applications of covariance analysis simulation to
Robust flight control - A design example	avionics flight testing
A82-1	
Computational methods of robust controller design	gn CRACK PROPAGATION
for aerodynamic flutter suppression	Study of the load-carrying capacity of aviation
	12080 gas-turbine engine impellers under low-cycle
Fixed gain controller design for aircraft	loading at normal and high temperatures
[AD-A104877] N82-1	
Flight test experience with high-alpha control	CRASHES Design of a crashworthy crew seat for the Boeing
system techniques on the F-14 airplane	Vertol Chinook helicopter
	13906 A82-1497
Comparison of low-speed handling qualities in	Crashworthy military passenger seat development
ground-based and in-flight simulator tests	A 82-1497
[AIAA PAPEE 81-2478] A82-1	13936 HASEP - Survival from crashed Navy helicopters .
Modeling procedures for handling qualities	A82-1497
evaluation of flexible aircraft	CREEP BUPTURE STRENGTH
	13968 Creep and aero gas turbine design
In-flight deflection measurement of the HiMAT	CREW STATIONS
aeroelastically tailored wing [AIAA PAPER 81-2450] A82-1	14381 An advanced programmable/reconfigurable color
Enhanced aircraft handling qualities by	graphics display system for crew station
longitudinal dynamics mode decoupling	technology research
	14826 [AIAA 81-2314] A82-1351
Limited evaluation of an F-14A airplane utilizing	
an aileron-rudder interconnect control system	
the landing configuration	(normal-force) pitch/yaw and roll dynamic
[NASA-TM-81972] N82-1	
CONTROLLERS Computational methods of robust controller design	cross, and cross-coupling derivatives GD-A1051221 N82-1204
Computational methods of robust controller design for aerodynamic flutter suppression	gn [AD-A105122] N82-1204 CRYOGENIC WIND TUNNELS
	12080 The development of cryogenic wind tunnels and
CONVERGENT NOZZIES	their application to maneuvering aircraft
Performance assessment of an advanced reheated	technology
turbo fan engine	A82-1397
[AIAA PAPEE 81-2447] A82-1	13879 CYCLIC LOADS
The subsonic performance of practical military	Study of the load-carrying capacity of aviation
variable area convergent nozzles	gas-turbine engine impellers under low-cycle
variable area convergent nozzles N82-1	gas-turbine engine impellers under low-cycle 13076 loading at normal and high temperatures
variable area convergent nozzles N82-1 Comparison of different nozzle concepts for a	gas-turbine engine impellers under low-cycle
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan	gas-turbine engine impellers under low-cycle 13076 loading at normal and high temperatures A82-1548
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1	gas-turbine engine impellers under low-cycle 13076 loading at normal and high temperatures
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors	gas-turbine engine impellers under low-cycle 13076 loading at normal and high temperatures A82-1548
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083]	gas-turbine engine impellers under low-cycle 13076 loading at normal and high temperatures A82-1548 13077 D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVERGENT-DIVERGENT NOZZLES	gas-turbine engine impellers under low-cycle 13076 loading at normal and high temperatures A82-1548 13077 DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAP P-106A aircraft
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVERGENT-DIVENGENT NOZZLES Comparison of different nozzle concepts for a	gas-turbine engine impellers under low-cycle 13076 loading at normal and high temperatures A82-1548 13077 DAMAGE ASSESSMENT 13835 Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] N82-1205
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 'Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVENCENT-DIVENCENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 D DAMAGE ASSESSMENT 13835 Investigation of severe lightning strike incidents to two USAF P-106A aircraft [NASA-CR-165794] DAMPING DAMPING
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVERGENT-DIVERGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1	gas-turbine engine impellers under low-cycle 13076 loading at normal and high temperatures A82-1548 13077 D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] DAMPING Experimental and analytical studies of advanced
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 (Investigation of acoustic interactions in jet thrust augmenting ejectors (AD-A106083) CONVERGENT-DIVERGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] DAMPING Experimental and analytical studies of advanced air cushion landing systems
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 *Investigation of acoustic interactions in jet thrust augmenting ejectors (AD-A106083] CONVERGENT-DIVENGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF P-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] N82-1 CONVENCENT-DIVENGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cocling requirements	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 D DAMAGE ASSESSMENT 13835 Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] DATA ACQUISITION
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVERGENT-DIVERGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cccling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cocling system for the Sea	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF P-106A aircraft [NASA-CR-165794] Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] DATA ACQUISITION The development and use of a computer-interactive
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 'Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVENCENT-DIVENGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cocling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cocling system for the Sea King MK-50 helicopter	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF P-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] N82-1 CONVENCENT-DIVENGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cooling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cooling system for the Sea King MK.50 helicopter [AD-A105211]	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPEE 81-2371] A82-1394
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 (Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVERGENT-DIVERGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cocling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cocling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF P-106A aircraft [NASA-CR-165794] Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPEE 81-2371] AFFTC standard airspeed calibration procedures
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVERGENT-DIVERGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cccling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cocling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPEE 81-2371] AFFTC standard airspeed calibration procedures [AD-A104830] N82-1207
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] N82-1 CONVENCENT-DIVENGENT MOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cccling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cocling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminate diffusion coating	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 D D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF P-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPEE 81-2371] A82-1394 AFFTC standard airspeed calibration procedures [AD-A104830] An acquisition and analysis system for dynamic
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] N82-1 CONVENCENT-DIVENGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cooling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cooling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminde diffusion coating	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPEE 81-2371] A82-1394 AFFTC standard airspeed calibration procedures [AD-A104830] N82-1207 An acquisition and analysis system for dynamic tests of air inlets
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVERGENT-DIVERGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cocling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cocling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminde diffusion coating A82-1 Attack on superalloys by chemical and electrolyse	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPEE 81-2371] A82-1394 AFFTC standard airspeed calibration procedures [AD-A104830] N82-1207 An acquisition and analysis system for dynamic tests of air inlets
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 'Investigation of acoustic interactions in jet thrust augmenting ejectors (AD-A106083) CONVENCENT-DIVENGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cocling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cocling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminate diffusion coating Attack on superalloys by chemical and electroly processes	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF P-106A aircraft [NASA-CR-165794] Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPEE 81-2371] AFFTC standard airspeed calibration procedures [AD-A104830] An acquisition and analysis system for dynamic tests of air inlets N82-1308
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVENCENT-DIVERGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cooling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cooling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminde diffusion coating A82-1 Attack on superalloys by chemical and electroly processes A82-1 COST ANALYSIS	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 D D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF P-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPER 81-2371] A82-1394 AFFTC standard airspeed calibration procedures [AD-A104830] An acquisition and analysis system for dynamic tests of air inlets DATA BASES
variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVERGENT-DIVERGENT MOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cocling requirements [AIAA PAPEN 81-2446] A vapour cycle cabin cocling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminde diffusion coating A82-1 Attack on superalloys by chemical and electrolytoprocesses A82-1 COST ANALYSIS Costs of noise nuisance from aircraft	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF P-106A aircraft [NASA-CR-165794]
Variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVENCENT-DIVENGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cocling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cocling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminate diffusion coating Attack on superalloys by chemical and electrolymprocesses COST ANALYSIS Costs of noise nuisance from aircraft	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF P-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPEE 81-2371] AFFTC standard airspeed calibration procedures [AD-A104830] An acquisition and analysis system for dynamic tests of air inlets N82-1308 DATA BASES Aircraft alerting systems standardization study (AIAA 81-2242) A82-1346 DATA COMPRESSION Automatic digital gain ranging for flight test
Variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 (Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVENCENT-DIVENGENT NOZZIES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cooling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cooling system for the Sea King MK.50 helicopter [AD-A105211] CORROSTON PREVENTION The protection of gas turbine blades - A plating aluminide diffusion coating A82-1 Attack on superalloys by chemical and electroly processes A82-1 COST ANALYSIS Costs of noise nuisance from aircraft A82-1 COST EPPECTIVENESS	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPEE 81-2371] A82-1394 AFFTC standard airspeed calibration procedures [AD-A104830] An acquisition and analysis system for dynamic tests of air inlets N82-1308 DATA BASES Aircraft alerting systems standardization study [AIAA 81-2242] DATA COMPRESSION Automatic digital gain ranging for flight test telemetry data
Variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVENCENT-DIVERGENT NOZZLES COMPARISON of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cooling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cooling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminde diffusion coating Attack on superalloys by chemical and electroly processes ACCOST ANALYSIS Costs of noise nuisance from aircraft COST EFFECTIVENESS A cost effective method for the control of roll	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPEE 81-2371] A82-1394 AFFTC standard airspeed calibration procedures [AD-A104830] N82-1207 An acquisition and analysis system for dynamic tests of air inlets N82-1308 DATA BASES Aircraft alerting systems standardization study [AIAA 81-2242] A82-1346 DATA COMPERSSION Automatic digital gain ranging for flight test telemetry data [AIAA PAPEE 81-2370] A82-1394
Variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVENCENT-DIVENGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cocling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cocling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminate diffusion coating Attack on superalloys by chemical and electroly processes COST ANALYSIS Costs of noise nuisance from aircraft COST EFFECTIVENESS A cost effective method for the control of roll due to side slip on a low speed aircraft	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 D D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF P-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPEE 81-2371] A82-1394 AFFTC standard airspeed calibration procedures [AD-A104830] N82-1207 An acquisition and analysis system for dynamic tests of air inlets N82-1308 DATA BASES Aircraft alerting systems standardization study [AIAA 81-2242] A82-1346 DATA COMPRESSION Automatic digital gain ranging for flight test telemetry data [AIAA PAPEE 81-2370] A82-1394 DATA LIBES
Variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVENCENT-DIVENGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cccling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cocling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminate diffusion coating Attack on superalloys by chemical and electroly processes COST ANALYSIS Costs of noise nuisance from aircraft COST EPPECTIVENESS A cost effective method for the control of roll due to side slip on a low speed aircraft [AIAA PAPER 81-2422] A82-1	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPEE 81-2371] A82-1394 AFFTC standard airspeed calibration procedures [AD-A104830] An acquisition and analysis system for dynamic tests of air inlets N82-1308 DATA BASES Aircraft alerting systems standardization study [AIAA 81-2242] DATA COMPRESSION Automatic digital gain ranging for flight test telemetry data [AIAA PAPEE 81-2370] DATA LIBES Distributed Time Division Bultiple Access /DTDMA/
Variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVERGENT-DIVENGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cooling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cooling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminide diffusion coating Attack on superalloys by chemical and electroly processes ACOST ANALYSIS Costs of noise nuisance from aircraft COST EFFECTIVENESS A cost effective method for the control of roll due to side slip on a low speed aircraft [AIAA PAPER 81-2422] COST ESTIMATES	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPER 81-2371] A82-1394 AFFTC standard airspeed calibration procedures [AD-A104830] N82-1207 An acquisition and analysis system for dynamic tests of air inlets N82-1308 DATA BASES Aircraft alerting systems standardization study [AIAA 81-2242] A82-1346 DATA COMPRESSION Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] A82-1394 DATA LIBKS Distributed Time Division Multiple Access /PTDMA/ - A distributed signaling technique for advanced
Variable area convergent nozzles N82-1 Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVENCENT-DIVENGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cccling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cocling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminate diffusion coating Attack on superalloys by chemical and electroly processes COST ANALYSIS Costs of noise nuisance from aircraft COST EPPECTIVENESS A cost effective method for the control of roll due to side slip on a low speed aircraft [AIAA PAPER 81-2422] A82-1	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 13077 DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPER 81-2371] A82-1394 AFFTC standard airspeed calibration procedures [AD-A104830] N82-1207 An acquisition and analysis system for dynamic tests of air inlets N82-1308 DATA BASES Aircraft alerting systems standardization study [AIAA 81-2242] A82-1346 DATA COMPRESSION Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] A82-1394 DATA LIBKS Distributed Time Division Multiple Access /PTDMA/ - A distributed signaling technique for advanced
Variable area convergent nozzles Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVENCENT-DIVENGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cooling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cooling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminate diffusion coating Attack on superalloys by chemical and electroly processes COST ANALYSIS Costs of noise nuisance from aircraft COST RPPECTIVENESS A cost effective method for the control of roll due to side slip on a low speed aircraft [AIAA PAPER 81-2422] A82-COST ESTIMATES A new approach to modeling the cost of ownership for aircraft systems	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 D DAHAGE ASSESSHENT Investigation of severe lightning strike incidents to two USAF P-106A aircraft [NASA-CR-165794] BAPPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPEE 81-2371] AFFTC standard airspeed calibration procedures [AD-A104830] An acquisition and analysis system for dynamic tests of air inlets N82-1308 DATA BASES Aircraft alerting systems standardization study [AIAA 81-2242] BATA COMPRESSION Automatic digital gain ranging for flight test telemetry data [AIAA PAPEE 81-2370] BATA LINKS Distributed Time Division Multiple Access /CTDMA/ - A distributed signaling technique for advanced p DATA HANAGEBERT
Variable area convergent nozzles (Comparison of different nczzle concepts for a reheated turbofan N82-1 (Investigation of acoustic interactions in jet thrust augmenting ejectors (AD-A106083] CONVENCENT-DIVENGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cooling requirements (AIAA PAPER 81-2446) A vapour cycle cabin cooling system for the Sea King MK.50 helicopter (AD-A105211) CORROSION PREVENTION The protection of gas turbine blades - A plating aluminate diffusion coating Attack on superalloys by chemical and electrolymprocesses Acost of noise nuisance from aircraft COST EMPLOYIUSESS A cost effective method for the control of roll due to side slip on a low speed aircraft (AIAA PAPER 81-2422) COST ESTIMATES A new approach to modeling the cost of ownership for aircraft systems [AD-A104434] COUPLED HODES	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 D D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AITAM FAPEE 81-2371] APFTC standard airspeed calibration procedures [AD-A104830] An acquisition and analysis system for dynamic tests of air inlets N82-1308 DATA COMPRESSION Automatic digital gain ranging for flight test telemetry data [AITAM PAPEE 81-2370] DATA LIBES Distributed Time Division Multiple Access / DTDMA/ - A distributed signaling technique for advanced tactical communications
Variable area convergent nozzles Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVENCENT-DIVENGENT NOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cocling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cocling system for the Sea King MK.50 helicopter [AD-A105211] COBROSION PREVENTION The protection of gas turbine blades - A plating aluminate diffusion coating Attack on superalloys by chemical and electroly processes COST ANALYSIS Costs of noise nuisance from aircraft COST EFFECTIVENESS A cost effective method for the control of roll due to side slip on a low speed aircraft [AIAA PAPER 81-2422] COST ESTIMATES A new approach to modeling the cost of ownership for aircraft systems [AD-A104434] COUPLED MODES Enhanced aircraft handling qualities by	gas-turbine engine impellers under low-cycle loading at normal and high temperatures 882-1548 D D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPER 81-2371] A82-1394 AFFTC standard airspeed calibration procedures [AD-A104630] An acquisition and analysis system for dynamic tests of air inlets tic DATA BASES Aircraft alerting systems standardization study [AIAA 81-2242] DATA COMPRESSION Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] A82-1394 DATA LIBES Distributed Time Division Multiple Access /DTDMA/ - A distributed signaling technique for advanced tactical communications A82-1471 DATA MAMAGEMENT Two at a time - Flight test plans for the new Boeing airliners
Variable area convergent nozzles Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVENCENT-DIVENGENT MOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cccling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cocling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminate diffusion coating Attack on superalloys by chemical and electroly processes COST ANALYSIS Costs of noise nuisance from aircraft COST EFFECTIVENESS A cost effective method for the control of roll due to side slip on a low speed aircraft [AIAA PAPER 81-2422] COST ESTIMATES A new approach to modeling the cost of ownership for aircraft systems [AD-A104434] Enhanced aircraft handling qualities by longitudinal dynamics mode decoupling	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 D D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF P-106A aircraft [NASA-CR-165794] DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [ADAI 104630] An acquisition and analysis system for dynamic tests of air inlets IA364 tic DATA BASES Aircraft alerting systems standardization study [AIAA 81-2242] DATA COMPRESSION Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] DATA LIBES Distributed Time Division Multiple Access /CTDMA/ - A distributed signaling technique for advanced tactical communications A82-1471 Two at a time - Flight test plans for the new Boeing airliners [AIAA PAPER 81-2378] A82-1394
Variable area convergent nozzles Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVENCENT-DIVENGENT MOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cccling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cocling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminate diffusion coating Attack on superalloys by chemical and electroly processes COST ANALYSIS Costs of noise nuisance from aircraft COST EFFECTIVENESS A cost effective method for the control of roll due to side slip on a low speed aircraft [AIAA PAPER 81-2422] COST ESTIMATES A new approach to modeling the cost of ownership for aircraft systems [AD-A104434] Enhanced aircraft handling qualities by longitudinal dynamics mode decoupling	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 D D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF F-106A aircraft [NASA-CR-165794] N82-1205 DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [AIAA FAPER 81-2371] A82-1394 APFTC standard airspeed calibration procedures [AD-A104830] N82-1207 An acquisition and analysis system for dynamic tests of air inlets DATA BASES Aircraft alerting systems standardization study [AIAA 81-2242] N82-1346 DATA COMPRESSION 13314 Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] A82-1394 DATA LIBES Distributed Time Division Multiple Access /DTDMA/ - A distributed signaling technique for advanced tactical communications A82-1471 Two at a time - Plight test plans for the new Boeing airliners [AIAA PAPER 81-2378] A82-1394 Algorithms for an adaptive dynamic window in
Variable area convergent nozzles Comparison of different nczzle concepts for a reheated turbofan N82-1 Investigation of acoustic interactions in jet thrust augmenting ejectors [AD-A106083] CONVENCENT-DIVENGENT MOZZLES Comparison of different nozzle concepts for a reheated turbofan N82-1 COOLING SYSTEMS Flight test method for the determination of reciprocating engine cccling requirements [AIAA PAPER 81-2446] A vapour cycle cabin cocling system for the Sea King MK.50 helicopter [AD-A105211] CORROSION PREVENTION The protection of gas turbine blades - A plating aluminate diffusion coating Attack on superalloys by chemical and electroly processes COST ANALYSIS Costs of noise nuisance from aircraft COST EFFECTIVENESS A cost effective method for the control of roll due to side slip on a low speed aircraft [AIAA PAPER 81-2422] COST ESTIMATES A new approach to modeling the cost of ownership for aircraft systems [AD-A104434] Enhanced aircraft handling qualities by longitudinal dynamics mode decoupling	gas-turbine engine impellers under low-cycle loading at normal and high temperatures A82-1548 D D DAMAGE ASSESSMENT Investigation of severe lightning strike incidents to two USAF P-106A aircraft [NASA-CR-165794] DAMPING Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] N82-1206 DATA ACQUISITION The development and use of a computer-interactive data acquisition and display system in a flight environment [ADAI 104630] An acquisition and analysis system for dynamic tests of air inlets IA364 tic DATA BASES Aircraft alerting systems standardization study [AIAA 81-2242] DATA COMPRESSION Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] DATA LIBES Distributed Time Division Multiple Access /CTDMA/ - A distributed signaling technique for advanced tactical communications A82-1471 Two at a time - Flight test plans for the new Boeing airliners [AIAA PAPER 81-2378] A82-1394

DATA PROCESSING SUBJECT INDEX

DATA PROCESSING	
	DEFLECTORS
Digital avionics display processor	Transonic flows in an air inlet with large
[AIAA 81-2311] A82-13513	incidence and the effect of a blowing trap
Time-referencing of data in an asynchronous	N82-13071
environment for fighter aircraft avionics	DEFORMATION
	Measured pavement response to transient aircraft
Recent improvements at the Naval Air Test Center	loadings
for increased test system flexibility	N82-13442
[AIAA PAPER 81-2392] A82-13888	DEGREES OF FREEDOM
Pleet Flight Loads Survey monitoring and analysis	Analysis of escape systems at 687 KBAS
	andrights of escape systems at 50, kms
techniques	A82-14978
[AIAA PAPER 81-2461] A82-13903	DBNSITY MEASUREMENT
The Advanced Range Instrumentation Aircraft	Formulation and characterization of polynmide
improvement and modernization program	resilient foams of various densities for
[AIAA PAPER 81-2368] A82-13948	aircraft seating applications
Status and tracking system for flight test data	[NASA-CR-167421] N82-12230
products	DEPOSITS
[AIAA PAPER 81-2395] A82-14376	Determination and analysis of jet and missile fuel
Integrated flight testing based on nonlinear	deposits
system identification data processing techniques	[AD-A105458] N82-12248
[AIAA PAPEE 81-2449] A82-14389	DESCRIT TRAJECTORIES
A multimicroprocessor system for ATCEBS monopulse	Flight investigations of integrated descent rate
data processing	
	control systems
A82-14777	A82-14929
DATA RECORDERS	DESCRIPTIONS
Extended time radar raw video recording	Orienting description of air traffic control in
A82-14909	the Netherlands
DATA REDUCTION	[VTH-LR-285] N82-12063
On matching the systems identification technique	
	DESIGN ANALYSIS
to the particular application in evaluating	Air-to-ground MTI radar using a displaced phase
flight test data	center, phased array
A82-13119	A82-14881
DATA STORAGE	The history of the development of the GQ
A storage device for subsystem maintenance	aeroconical parachute - 1971-1980
information	
	A82-14961
A82-14817	A look at the Hoffman Triangular parachute - The
DATA SYSTEMS	first successful glidable parachute
Development and laboratory test of an integrated	A82-14966
sensory system /ISS/ for advanced aircraft	Mathematical programming in engineering design
[AIAA 81-2297] A82-13504	problems
Advanced fiber optic systems for avicnics	A82-15864
applications	Design study report for General Aviation Loran-C
[AIAA 81-2319] A82-13518	receiver
A technique to determine lift and drag polars in	[AD-A104921] N82-12062
flight and their application	Establishment of an experimental technique to
[AIAA PAPEE 81-2420] A82-13859	provide accurate measurement of the installed
An advanced facility for processing aircraft	drag of close coupled civil nacelle/airframe
dynamic test data	configurations, using a full span model with
[AIAA PAPER 81-2398] A82-14377	turbine powered engine simulators
DATA TRANSBISSION	N82-13089
ABINC 429 digital data communications on the	DETECTION
	Sensor failure detection system for the F100
Boeing 757 and 767 commercial airliners	
[AIAA 81-2267] A82-13485	turbofan engine
[AIAA 81-2267] Higher order Information Transfer Systems are coming	turbofan engine [NASA-CR-165515] N82-13145
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] A82-13517	turbofan engine
[AIAA 81-2267] Higher order Information Transfer Systems are coming	turbofan engine [NASA-CR-165515] N82-13145
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] A82-13517 Light-guided information distribution systems	turbofan engine [NASA-CR-165515] N82-13145 DIESEL PUELS Development of catalytic systems for the
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] A82-13519	turbofan engine [NASA-CR-165515] DIESBL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops	turbofan engine [NASA-CR-165515] DIESEL FUELS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] A82-13517 Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-14696	turbofan engine [NASA-CR-165515] DIRSEL FUELS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] N82-12255
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications	turbofan engine [NASA-CR-165515] N82-13145 DIESEL PUELS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] N82-12255 DIFFUSION PLANES
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725	turbofan engine [NASA-CR-165515] DIESBL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] N82-12255 DIFFUSICE FLAMES Chemistry of combustion of fuel-water mixtures
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] A82-13519 High speed microwave phase-locked loops Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system	turbofan engine [NASA-CR-165515] DIESBL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] N82-12255 DIFFUSION PLANES
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725	turbofan engine [NASA-CR-165515] DIESBL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] N82-12255 DIFFUSICE FLAMES Chemistry of combustion of fuel-water mixtures
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] A82-13519 High speed microwave phase-locked loops Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system	turbofan engine [NASA-CR-165515] DIESEL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] N82-12255 DIFFUSICH FLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] N82-12304	turbofan engine [NASA-CR-165515] DIESEL PUELS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] DIPFUSICE PLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] N82-12304 DC 9 AIRCRAFT	turbofan engine [NASA-CR-165515] DIESBL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DB82-000067] DIFFUSICN FLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] DIGITAL DATA Automatic digital gain ranging for flight test telemetry data
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops Using phased array radar for data communications A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] DC 9 AIRCHAPT Applications of digital avionics to commercial	turbofan engine [NASA-CR-165515] DIESBL FUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] DIFFUSICH FLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [ALAA PAPER 81-2370] A82-13947
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 Using phased array radar for data communications A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] N82-12304 DC 9 AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond	turbofan engine [NASA-CR-165515] DIESEL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] DIPFUSICE PLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airtorne Electronic Terrain Map System
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] DC 9 AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] A82-13456	turbofan engine [NASA-CR-165515] DIESBL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] DIPPUSICN PLANES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airlorne Electronic Terrain Map System
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 Using phased array radar for data communications A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] N82-12304 DC 9 AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond	turbofan engine [NASA-CR-165515] DIESEL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] DIPFUSICE PLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airtorne Electronic Terrain Map System
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] DC 9 AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] DC 10 AIRCRAFT	turbofan engine [NASA-CR-165515] DIESBL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DB82-000067] DIPPUSICH PLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPEE 81-2370] Airlorne Electronic Terrain Map System N82-14771 DIGITAL FILTERS
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] DC 9 AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] A82-13456	turbofan engine [NASA-CR-165515] DIESEL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] DIFFUSION FLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAM PAPER 81-2370] Airlorne Electronic Terrain Map System A82-14771 DIGITAL PILTERS The agile transversal filter - A flexible building
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] N82-12304 DC 9 AIRCEAPT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] DC 10 AIRCRAFT KC-10, flight test program management - The contractor's viewpoint	turbofan engine [NASA-CR-165515] DIESEL PUELS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] DIPFUSICH PLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airlorne Electronic Terrain Map System N82-14771 DIGITAL PILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications,
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops 882-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] DC 9 AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] A82-13456 DC 10 AIRCRAFT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] A82-14384	turbofan engine [NASA-CR-165515] DIESBL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DB82-000067] DIPPUSICN PLANES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12255 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airlorne Electronic Terrain Map System A82-14771 DIGITAL PLITERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops 882-13519 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] DC 9 AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] A82-13456 DC 10 AIRCRAFT KC-10, flight test program management - The contractor's viewpcint [AIAA PAPEE 81-2380] DE HAVILLAND AIRCRAFT	turbofan engine [NASA-CR-165515] DIESBL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DB82-000067] DIPPUSICH PLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12255 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPEE 81-2370] Airlorne Electronic Terrain Map System A82-14771 DIGITAL PILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 Bigh speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] BC 9 AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] BC 10 AIRCRAFT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] BE HAVILLAND AIRCRAFT Flight testing De Havilland Aircraft Limited	turbofan engine [NASA-CR-165515] DIESEL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] N82-12255 DIPFUSICH FLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airlorne Electropic Terrain Map System N82-14771 DIGITAL PILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics DIGITAL INTEGRATORS
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] A82-13517 Light-guided information distribution systems [AIAA 81-2320] A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] BOS 9 AIRCEAPT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] BC 10 AIRCRAFT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] BHAVILLAND AIRCRAFT Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by	turbofan engine [NASA-CR-165515] DIESEL PUELS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] DIPFUSICH PLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airlorne Electronic Terrain Map System A82-14771 DIGITAL FILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics A82-14765 DIGITAL INTEGRATORS Techniques for interfacing multiplex systems
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] DC 9 AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] A82-13456 DC 10 AIRCRAFT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] DB HAVILLAND AIRCRAFT Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor	turbofan engine [NASA-CR-165515] DIESBL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DB82-000067] DIPPUSICN PLANES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12255 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airlorne Electronic Terrain Map System A82-14771 DIGITAL PILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics A82-14765 DIGITAL INTEGRATORS Techniques for interfacing multiplex systems [AD-A101457] N82-13135
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] DC 9 AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] A82-13456 DC 10 AIRCRAFT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] DB HAVILLAND AIRCRAFT Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPEE 81-2507] A82-13907	turbofan engine [NASA-CR-165515] DIESEL PUELS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] DIPFUSICH PLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airlorne Electronic Terrain Map System A82-14771 DIGITAL FILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics DIGITAL INTEGRATORS Techniques for interfacing multiplex systems
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] DC 9 AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] A82-13456 DC 10 AIRCRAFT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] DB HAVILLAND AIRCRAFT Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor	turbofan engine [NASA-CR-165515] DIESEL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] DIFFUSION FLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAM PAPER 81-2370] Airlorne Electronic Terrain Map System A82-14771 DIGITAL PILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics DIGITAL INTEGRATORS Techniques for interfacing multiplex systems [AD-A101457] DIGITAL NAVIGATION
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] DC 9 AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] DC 10 AIRCRAFT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] DB HAVILLAND AIRCRAFT Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPEE 81-2507] DECELERATION	turbofan engine [NASA-CR-165515] DIESEL PUELS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-00067] DIPFUSICE PLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airlorne Electronic Terrain Map System N82-14771 DIGITAL PILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics DIGITAL INTEGRATORS Techniques for interfacing multiplex systems [AD-A101457] DIGITAL NAVIGATION Digital redesign of existing multiloop continuous
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] BOS 9 AIRCEAPT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] BC 10 AIRCEAPT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] BC HAVILLAND AIRCEAPT Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPEE 81-2507] BCCELERATION Escape systems decelerator technology	turbofan engine [NASA-CR-165515] DIESEL PUELS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] DIPFUSICE PLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airlorne Electronic Terrain Map System A82-14771 DIGITAL PILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics DIGITAL INTEGRATORS Techniques for interfacing multiplex systems [AD-A101457] DIGITAL NAVIGATION Digital redesign of existing multiloop continuous control systems with application to YF-16
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] BC 9 AIRCBAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] A82-13456 BC 10 AIRCBAFT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] BE HAVILLAND AIRCRAFT Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPEE 81-2507] A82-13907 DECELERATION Escape systems decelerator technology [AIAA PAPEE 81-1913] A82-13966	turbofan engine [NASA-CR-165515] DIESBL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DB82-000067] DIPPUSICN PLANES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12255 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airlorne Electronic Terrain Map System A82-14771 DIGITAL PILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics A82-14765 DIGITAL INTEGRATORS Techniques for interfacing multiplex systems [AD-A101457] DIGITAL NAVIGATION Digital NAVIGATION Digital NAVIGATION Digital redesign of existing multiplop continuous control systems with application to YF-16 aircraft flight controller
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] DC 9 AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] BC 10 AIRCRAFT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] DE HAVILLAND AIRCRAFT Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPEE 81-2507] DECELERATION Escape systems decelerator technology [AIAA PAPEE 81-1913] DECOUPLING	turbofan engine [NASA-CR-165515] DIESEL PUBLS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] DIFFUSICH FLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airlorne Electronic Terrain Map System A82-14771 DIGITAL PILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics DIGITAL INTEGRATORS Techniques for interfacing multiplex systems [AD-A101457] DIGITAL NAVIGATION Digital redesign of existing multiloop continuous control systems with application to YF-16 aircraft flight controller
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] A82-13517 Light-guided information distribution systems [AIAA 81-2320] A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] BOS AIRCHAPT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] BC 10 AIRCHAPT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] BE HAVILLAND AIRCHAPT Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPEE 81-2507] BECELERATION Escape systems decelerator technology [AIAA PAPEE 81-1913] BECOUPLING A decoupled control system for improved flight	turbofan engine [NASA-CR-165515] DIESEL PUELS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-00067] DIFFUSICE PLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airlorne Electronic Terrain Map System DIGITAL PILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics DIGITAL INTEGRATORS Techniques for interfacing multiplex systems [AD-A101457] DIGITAL NAVIGATION Digital redesign of existing multiloop continuous control systems with application to YF-16 aircraft flight controller A82-13093 Digital control for flexible aircraft using
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] A82-13517 Light-guided information distribution systems [AIAA 81-2320] A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] BOS 9 AIRCHAPT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] BC 10 AIRCRAPT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] BHAVILLAND AIRCRAPT Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPEE 81-2507] BECELERRATION Escape systems decelerator technology [AIAA PAPEE 81-1913] BECOUPLING A decoupled control system for improved flight performance in wind shear	turbofan engine [NASA-CR-165515] DIESEL PUELS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] DIPFUSICE PLANES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airlorne Electronic Terrain Map System A82-14771 DIGITAL PLITERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics DIGITAL INTEGRATORS Techniques for interfacing multiplex systems [AD-A101457] DIGITAL NAVIGATION Digital redesign of existing multiloop continuous control systems with application to YF-16 aircraft flight controller A82-13093 Digital control for flexible aircraft using reduced order models
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] DC 9 AIRCHAPT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] A82-13456 DC 16 AIRCHAPT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] A82-14384 DB HAVILLAND AIRCHAPT Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPEE 81-2507] BCCELERATION ESCAPE systems decelerator technology [AIAA PAPEE 81-1913] DECOUPLING A decoupled control system for improved flight performance in wind shear	turbofan engine [NASA-CR-165515] DIESEL PUELS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-00067] DIFFUSICE PLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPER 81-2370] Airlorne Electronic Terrain Map System DIGITAL PILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics DIGITAL INTEGRATORS Techniques for interfacing multiplex systems [AD-A101457] DIGITAL NAVIGATION Digital redesign of existing multiloop continuous control systems with application to YF-16 aircraft flight controller A82-13093 Digital control for flexible aircraft using
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] DC 9 AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] DC 10 AIRCRAFT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] DE HAVILIAND AIRCRAFT Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPEE 81-2507] DECELERATION Escape systems decelerator technology [AIAA PAPEE 81-1913] DECOUPLING A decoupled control system for improved flight performance in wind shear	turbofan engine [NASA-CR-165515] DIESEL PUELS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-000067] DIFFUSION FLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAM PAPER 81-2370] Airlorne Electronic Terrain Map System DIGITAL PILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics DIGITAL INTEGRATORS Techniques for interfacing multiplex systems [AD-A101457] DIGITAL NAVIGATION Digital redesign of existing multiloop continuous control systems with application to YF-16 aircraft flight controller A82-13093 Digital control for flexible aircraft using reduced order models
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] DC 9 AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] DC 10 AIRCRAFT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] DE HAVILIAND AIRCRAFT Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPEE 81-2507] DECELERATION Escape systems decelerator technology [AIAA PAPEE 81-1913] DECOUPLING A decoupled control system for improved flight performance in wind shear	turbofan engine [NASA-CR-165515] DIESEL PUELS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-00067] DIPFUSICE PLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPPE 81-2370] Airtorne Electronic Terrain Map System N82-14771 DIGITAL PILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics DIGITAL INTEGRATORS Techniques for interfacing multiplex systems [AD-A101457] DIGITAL NAVIGATION Digital redesign of existing multiloop continuous control systems with application to YF-16 aircraft flight controller A82-13093 Digital control for flexible aircraft using reduced order models A82-13094
[AIAA 81-2267] Higher order Information Transfer Systems are coming [AIAA 81-2317] Light-guided information distribution systems [AIAA 81-2320] High speed microwave phase-locked loops A82-13519 High speed microwave phase-locked loops A82-14696 Using phased array radar for data communications A82-14725 Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] DC 9 AIRCHAPT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and beyond [AIAA 81-2218] A82-13456 DC 16 AIRCHAPT KC-10, flight test program management - The contractor's viewpoint [AIAA PAPEE 81-2380] A82-14384 DB HAVILLAND AIRCHAPT Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPEE 81-2507] BCCELERATION ESCAPE systems decelerator technology [AIAA PAPEE 81-1913] DECOUPLING A decoupled control system for improved flight performance in wind shear	turbofan engine [NASA-CR-165515] DIESEL PUELS Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols [DE82-00067] DIPFUSICE PLAMES Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12178 DIGITAL DATA Automatic digital gain ranging for flight test telemetry data [AIAA PAPPE 81-2370] Airtorne Electronic Terrain Map System N82-14771 DIGITAL PILTERS The agile transversal filter - A flexible building block for ICNIA Integrated Communications, Navigation and Identification Avionics DIGITAL INTEGRATORS Techniques for interfacing multiplex systems [AD-A101457] DIGITAL NAVIGATION Digital redesign of existing multiloop continuous control systems with application to YF-16 aircraft flight controller A82-13093 Digital control for flexible aircraft using reduced order models A82-13094

SUBJECT INDEX DISPLAY DEVICES

DIGITAL BADAR SISTERS Radar hostile fire location	DIRECT CURRENT Computer modeling of an aircraft HVDC electrical
A82-14857 Air-to-ground MTI radar using a displaced phase	system A82-14819
center, phased array	DIRECTIONAL ANTENNAS
A82-14881 A new approach to radar plot extraction for ATC applications	Study of the effects of maneuver compensation on beam pointing accuracy A82-1478
A82-14908	DIRECTIONAL CONTROL
A failure detection and isolation system for	Design and flight test of a lateral-directional command augmentation system
tactical aircraft with separated IMUs	[AIAA 81-2331] A82-13527
A82-14684 Digital simulation of aircraft electrical	DIRECTIONAL SOLIDIFICATION (CRYSTALS) 'In situ' composites for jet propulsion and
generating system by means of Sceptre program	stationary gas turbine applications
A82-14820 General purpose real-time interaction panel for	DISCRETE ADDRESS BEACON SYSTEM
digital simulation of flight centrol systems A02-14831	Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control
A real time Pegasus propulsion system model for	Radar Beacon System
VSTOL piloted simulation evaluation [NASA-TM-82770] N82-13144	A82-14770
DIGITAL SYSTEMS	A multimicroprocessor system for ATCRBS monopulse data processing
Digital Avionics Systems Conference, 4th, St.	A82-1477
Louis, NO, November 17-19, 1981, Callection of Technical Papers	DISPLACEMENT MEASUREMENT In-flight deflection measurement of the HiMAT
A82-13451	aeroelastically tailored wing
Integrated avionics - Concepts and concerns [AIAA 81-2211] A82-13452	[AIAA FAPRE 81-2450] A82-1438 DISPLAY DEVICES
Digital avionics - What a pilot expects to see	Digital avionics - What a pilot expects to see
[AIAA 81-2217] A82-13455 Applications of digital avionics to commercial	[AIAA 81-2217] Assurance avionics
transport aircraft - The DC-9 Super 80 and beyond	[AIAA 81-2239] A82-1346
[AIAA 81-2218] A82-13456 The role of avionics in the all electric airplane	Aircraft alerting systems standardization study [AIAA 81-2242] A82-1346
[AIAA 81-2219] A82-13457	The application of large screen CRT's, touch
Pault isolation methodology for the I-1011 digital avionic flight control system	panels, and voice to the flight stations of the 1990's
[AIAA 81-2223] A82-13458	[AIAA 81-2263] A82-1348
Computer-in-control selection logic for a triplex	Electronic flight deck displays for transport
digital flight control system [AIAA 81-2236] A82-13465	aircraft [AIAA 81-2264] A82-1348:
Design and analysis of a digitally controlled	The electronic terrain map - A new avionics
integrated flight/fire control system [AIAA 81-2245] A82-13470	integrator [AIAA 81-2289] A82-1349
ARINC 429 digital data communications on the	The interface of multifunction controls and
Boeing 757 and 767 ccumercial airliners [AIAA 81-2267] A82-13485	displays to tomorrow's avionics [AIAA 81-2290] A82-1349
Direct digital drive actuation	Flat panel developments for future military aircraft
[AIAA 81-2298] A82-13505 Digital detection and processing of laser beacon	[AIAA 81-2302] An integrated control panel utilizing a
signals for aircraft collision hazard warning	programmable varistor-multiplexed dichroic
[AIAA 81-2328] A82-13525 Design and flight test of a lateral-directional	liquid crystal display [AIAA 81-2303] A82-1350
command augmentation system	Digital avionics display processor
[AIAA 81-2331] A82-13527 Advanced wearon systems - Integration technology	[AIAA 81-2311] Advanced display systems for crew stations of
Digital Avionic Information System .	tactical aircraft
[AIAA 81-2213] A82-13533 P/A-18 high authority/high gain digital flight	[AIAA 81-2312] A82-13514 Computergraphics for aircraft control
 control system development and flight testing 	[AIAA 81-2313] A82-1351
[AIAA PAPES 81-2465] A82-13930 Implementing the CAIS executive Digital	An advanced programmable/reconfigurable color graphics display system for crew station
Avionics Information System software feasibility	technology research
for aircraft systems A82-14814	[AIAA 81-2314] A82-1351 Application of a microprocessor controlled cockpit
Direct digital design method for reconfigurable	display for enhanced pilot control of flight
multivariable control laws for the A-7D Digitac II aircraft	test maneuvers [AIAA PAPER 81-2510] A82-1390
A82-14828	A unique integrated flight testing facility for
Design of direct digital flight-mode control systems for high-performance aircraft	advanced control/display research [AIAA PAPER 81-2490] A82-1391
A82-14829	The development and use of a computer-interactive
Reliability analysis of the F-8 digital fly-by-wire system	data acquisition and display system in a flight environment
[NASA-CR-163110] N82-12079	[AIAA PAPEE 81-2371] A82-1394
How the helicopter cockpit designer uses digital	The integration of control and display concepts
avionics B82-13049	for improved pilot situational awareness A82-1397
DIGITAL TECHNIQUES	Software considerations in the design of computer
Digital signal processing on a background of rereflections for the international aircraft	generated flight displays A82-1474
landing system	A methodology for missile launch envelope display
A82-13703 Parallel processing applied to digital flight	evaluation A82-1474
control systems - Some perspectives	Airborne color CRT displays
A82-14794 Microprocessor flight control application study	A82-1482
A82-14796	,

DIVERGENCE SUBJECT INDEX

The Maneuvering Plight Path Display - A fl	ight	DYNAMIC STABILITY	
trajectory sclution display concept	A82-14824	Direct free-flight analysis of aircraft dy at high angles of attack	
Computer smage generation for flight simular	A82-15599	Robust flight control - A design example	A82-15596
Computer-animated predictive displays for microwave landing approaches	A82-15816	Effects of aerodynamic coupling on the dyna roll aircraft	A82-15845 amics of
Experimental evaluation of a perspective to display for three-dimensional helicopter		DYNAMIC STRUCTURAL ANALYSIS	N82-12070
approaches	A82-15847	A set of finite elements developed for the computation of composite helicopter blade	
Electronic Haster Monitor and Advisory Dis System (EMMADS) [AD-A105082]	_	[ONERA, TP NO. 1981-87] Application of the OMERA dynamic stall mode helicopter blade in forward flight	A82-13990
The impact of new guidance and control sysmilitary aircraft cockpit design [AGARD-CP-312]		[ONERN, TP NO. 1981-89] Structural dynamics: Modified calculation:	
Electronic flight deck displays for milita: transport aircraft		natural and harmonically excited vibration modified structures; increased computation efficiency	
Color CRT displays for the cockpit	N82-13050	[BMVG-FBWT-81-1] DINAMIC TESTS	N82-13457
Integration of controls and displays in US	N82-13051 Army	An advanced facility for processing aircra: dynamic test data	
helicopter cockpits A standard control display unit for multi-	N82-13053 aircraft	[AIAA FAPER 81-2398] An acquisition and analysis system for dyntests of air inlets	A82-14377 amic
application	N82-13054		N82-13082
Tanker avionics and aircrew complement eva		E	
F/A 18 Hornet crew station	N82-13064	BCONOMIC ANALYSIS Transportation systems evaluation methodological	og y
Electronic master monitor and advisory dis system test and demonstration report	-	<pre>development and applications, phase 3 [NASA-CB-164999]</pre>	N82-12051
[AD-A105317] DIVERGENCE	N82-13141	BCONONIC IMPACT The FAA's proposed helicopter certification	
Divergence of a sweptforward wing	A82-13560	EGRESS	A82-13242
DIVERTERS Subsonic military aircraft engine intake: integrated theoretical experiment design	An	<pre>Emergency in-flight egress for general avi aircraft</pre>	ation A82-14953
DOORS	N 82-13073	BIGBEVALUES	
Subsonic military aircraft engine intake: integrated theoretical experiment design		A set of finite elements developed for the computation of composite helicopter blad [ONERA, TP NO. 1981-87]	
DRAG MEASUREMENT Model testing techniques for measuring inl	N82-13073	BJECTION INJURIES Wind tunnel tests of ejection seat for high dynamic pressure escape	h
DRAG REDUCTION	N82-13084		A82-14979
Analysis of escape systems at 687 KEAS	-02 4#070	Fost ejection survival	A82-14981
DUCT GEOMETRY	A82-14978	EJECTION SEATS Escape systems decelerator technology	
Effects of intake geometry on circular pit intake performance at zero and low forwa		[AIAA FAPER 81-1913] Testing of the SJU-5A ejection seat for the /HCENET/ aircraft	A82-13966 e F/A-18
Effect of vacuum exhaust pressure on the performance of MHD ducts at high D-field [NASA-TM-82750]	N82-13908	Further test results of parachutes with au inflation modulation /A.I.H./	A82-14955 tomatic
DYNAMIC CONTROL The design of exact nonlinear model follow			A82-14965
with application to trajectory autopilot helicopter		Analysis of escape systems at 687 KEAS Wind tunnel tests of ejection seat for hig	A82-14978
•	A82-13125	dynamic pressure escape	A82-14979
Application of the concept of dynamic trim and nonlinear system inverses to automat control of a vertical attitude takeoff a	ıc	Performance assessment of the ACES-II ejec seat-A-10 configuration	tion
landing aircraft [ATAA 81-2238]	A82-13466	Post ejection survival	≥82-14980
DYNAMIC LOADS Measured pavement response to transient ail loadings	rcraft	Terrain actuated deployment system rad altimeter for man-ejector seat separatio	
DYNAMIC MODRLS	N82-13442	RJECTORS	A82-14982
Performance estimation from non-steady man [AIAA PAPER 81-2424]	oeuvres A82-13863	Investigation of acoustic interactions in	jet
DYNAMIC PARSSURE Wind tunnel tests of ejection seat for hig		thrust augmenting ejectors [AD-A106083] BLASTIC DAMPIEG	N82-13835
dynamic pressure escape	- A82-14979	Design for active and passive flutter supp and gust alleviation	ression
DYNAMIC RESPONSE Evaluation and wind tunnel tests of the 4,		[NASA-CR-3482] BLASTIC DEFORMATION	N82-13147
(normal-force) pitch/yaw and roll dynami- stability balance systems for measuring	c	In-flight deflection measurement of the Hi aeroelastically tailored wing	MAT
cross, and cross-coupling derivatives [AD-A105122]	N82-12047	[AIAA PAPER 81-2450]	A82-14381

SUBJECT INDEX REGIES COOLANTS

RLECTRIC EQUIPMENT Computer modeling of an aircraft HVDC electrical system	New all-electric-system technology electromechanical actuators for aircraft A82-14710
A82-14819 Computer simulation of an advanced aircraft electrical system	High speed PMG containment study for VSCF system Fermanent Magnet Generator for Variable Speed Constant Frequency applications
A82-14821	A82-14791
BLECTRIC GENERATORS 60 kVA ADP permanent magnet VSCP starter generator system - A program overview Variable Speed	BLECTROBIC AIRCRAFT The role of avionics in the all electric airplane [AIAA 81-2219] A82-13457
Constant Frequency	The all electric airplane - Its development and
BLECTRIC POWER	logistic suffort A82-14709
Will power-by-wire replace power-by-hydraulics 882-14707	New all-electric-system technology electromechanical actuators for aircraft A82-14710
The all electric airplane - Its development and logistic support	Alrborne Electronic Map Systems. I - Design
BLECTRIC POWER SUPPLIES A82-14709	Alrborne Electronic Terrain Map System
Conceptual design of an integrated power and	A82-14771
avionics information system	BLECTROBIC CONTROL
A82-14788 60 kVA ADP permanent magnet VSCF starter generator	Algorithms for an adaptive dynamic window in electronic map systems
system - A program overview Variable Speed	A82-14769
Constant Prequency A82-14789 High speed PMG containment study for VSCP system	<pre>Pailure analysis of variable reluctance stepper motor in electronic fuel control system on jet engine</pre>
Permanent Magnet Generator for Variable	A82-14792
Speed Constant Frequency applications A82-14791	BLECTROBIC RQUIPHENT Blectronic flight deck displays for transport
Computer simulation of an advanced aircraft	alicraft
electrical system A82-14821	[AIAA 81-2264] A82-13483 The Advanced Bange Instrumentation Aircraft
ELECTRICAL ENGINEERING	improvement and modernization program
Compilation of abstracts of dissertations theses, and research papers submitted by candidates for	[AIAA FAPER 81-2368] A82-13948 Alrborne Electronic Terrain Map System. II -
degrees, 1 October 1979 - 30 September 1980	Applications
[AD-A104124] N82-13974	A82-14773 ELECTRONIC WARPARE
ELECTRO-OPTICAL PHOTOGRAPHY Weather impact on low-altitude imaging infrared	The TADS/PNVS 'eyes' for the AH-64 attack helicopter
sensors in Europe - An availability model	A82-13239
BLECTRO-OPTICS	Advanced fiber optic systems for avionics applications
The TADS/PNVS 'eyes' for the AH-64 attack helicopter A82-13239	[AIAA 81-2319] A02-13518 Study of the effects of maneuver compensation on
Electro-optical vector scoring system for missile miss distance in fleet training exercises	beam pointing accuracy A82-14780
[AIAA PAPER 81-2373] A82-13945	BLEVATORS (CCHTRCL SURFACES)
RLECTROCHEMICAL MACHINING Attack on superalloys by chemical and electrolytic	Trim tab excitation system for the BAe 146
**Processes	ELLIPTIC DIPPERENTIAL EQUATIONS
A82-14365 ELECTROMAGNETIC COMPATIBILITY	Rapid elliptic solvers A82-15827
The Navy F/A-18A Hornet electromagnetic	BMBRGBMCIES
compatibility program A82-14760	Plight testing the suspended maneuvering system helicopter firefighting and rescue techniques
ELECTROMAGNETIC INTERACTIONS Georgia Tech coherent jammer flight test	[AIAA PAPER 81-2498] A82-13922 BHERGY COMSERVATION
[AIAA PAPER 81-2452] A82-13898	Airplane performance sensitivities to lateral and
A concept for a high-accuracy, low-cost	vertical profiles A82-15846
accelerometer A82-14685	Analysis of integrated fuel-efficient, low-noise
Assessment methodology of the lightning threat to advanced aircraft	procedures in terminal-area operations [DB81-029833] N82-13014
A82-14759	BUGINE CONTROL
ELECTROMAGNETIC INTERFERENCE Piber-optic inmunity to EMI/EMP for military	The role of avionics in the all electric airplane [AIAA 81-2219] A82-13457
aircraft	Recent propulsion system flight tests at the NASA
[AIAA 81-2339] A82-13529 ELECTROMAGNETIC PULSES	Dryden Flight Besearch Center [AIAA PAPEE 81-2438] A82-13874
Fiber-optic immunity to REI/EMP for military	The development and flight test evaluation of an
aircraft [AIAA 81-2339] A82-13529	integrated propulsion control system for the Himan research airplane
A recursive time domain analysis of distributed	[AIAA PAPER 81-2467] A82-13931
line grid networks with application to the LTA/BMP problem Lightning Threat Analysis	<pre>Pailure analysis of variable reluctance stepper motor in electronic fuel control system on</pre>
A82-14761	jet engine
ELECTROMAGNETIC SHIELDING The Navy F/A-18A Hornet electromagnetic	A82-14792 Sensor failure detection system for the F100
compatibility grogram	turbofan engine
A82-14760	[NASA-CR-165515] N82-13145 BEGIER COCLARTS
60 kVA ADP permanent magnet VSCF starter generator	Flight test method for the determination of
system - A program overview Variable Speed	reciprocating engine cooling requirements [Alaa Faper 81-2446] A82-13878
Constant Frequency A82-14789	The operational characteristics of turbojets,
BLECTROBECHABICAL DEVICES	giving particular attention to the cooled
Electromechanical actuation development program A82-14705	high-pressore turbine A82-14414
=32 ******	11-11

REGIER DESIGN Creep and aero gas turbine design		Compressor stall inducing installation effe an engine control parameter for the CP-5	
	A82-12987		N82-13085
An approach to robust menlinear control desi- with illustration of J-85 turbojet engine		ESCAPE SYSTEMS Escape systems decelerator technology	
simulation CI7 - GE attacks commuter turboprop market	A82-13128	[AIAA PAPER 81-1913] Emergency in-flight egress for general avia aircraft	A82-13966 tion
	182-15950 engine		A82-14953
ınstallatıcı cı a fuselage afterbody	N82-13093	dynamic pressure escape	182-14979
An aerodynamic design and the overall stage performance of an air-cccled axial-flow to [NAL-TR-321T]	urbine 882-13109	A ballistic design model for initiators for aircraft personnel escape systems	182-14984
ENGINE INLETS A large-scale investigation of engine influe inlet performance at angle-of-attack		Analytical and experimental characterization the JAU-14/A cartridge actuated initiator use in aircrewescape system performance	n of
	182-13939 Vane on	evaluation	A82-14985
TP34 fan perfermance		BUTECTIC ALLOYS	
[NASA-CR-165458] Aerodynamics of Power Flant Installation	N82-12075	'In situ' composites for jet propulsion and stationary gas turbine applications	l
[AGABE-CP-301] Performance of highly integrated inlets for	182-13065	BVALUATION	A82-15824
supersonic aircraft	182-13066	Naval Weapons Center - Test and evaluation 1980's	in the
Some RAE research on shielded and unshielded fuselage mcunted air ıntakes at subsonic a	i		A82-13940
supersonic speeds	882-13068	Trim tab excitation system for the BAe 146	A82-14363
Prediction and measurement of time-variant, three-dimensional flows in military aircra		EXHAUST BHISSION Effect of fuel-air-ratio nonuniformity on	
intakes		emissions of hitrogen oxides	
Effects of intake geometry on circular pitot	182-13069		N82-13143
intake performance at zero and low forward		EXHAUST FLOW SIMULATION Wind tunnel test and analysis techniques us	:100
	182-13070	powered simulators for civil nacelle	Jing
Subsonic military aircraft engine intake: A integrated theoretical experiment design	ΔA	installation drag assessment	N82-13088
The design and development of the Tornado en air intake	182-13073 1gine	Establishment of an experimental technique provide accurate measurement of the instadrag of close coupled civil nacelle/airfr	lled
Wind tunnel tests of powered models: A comp		configurations, using a full span model w turbine powered engine simulators	ııth
of two methods of simulating the jets of gengines	-	EXHAUST BOZZLES	N82-13089
Numerical analysis of the scramjet-inlet flo	182-13087	An investigation of P-16 nozzle-afterbody f	
field by using two-dimensional Navier-Stok		at transonic Mach numbers with emphasis o scale effects [AD-A104905]	N82-12392
	182-13142	Aerodynamics of Power Plant Installation	
60 kVA ADP permanent magnet VSCF starter gen		[AGARD-CP-301] Integration of advanced exhaust nozzles	N82-13065
system - A program overview Variable S Constant Prequency	-	Advanced exhaust nozzle technology	N82-13075
ENGINE TESTS	182-14789	Evaluation of an experimental technique to	N82-13078
Recent propulsion system flight tests at the Dryden Flight Research Center		<pre>investigate the effects of the engine pos on engine/pylcn/wing interference</pre>	
Performance assessment of an advanced reheat	182-13874 :ed	EXHAUST SYSTEMS	N82-13090
	182-13879	Investigation of acoustic interactions in judgmenting ejectors	jet
ENGINEERING MANAGEMENT Organizing and training for innovative fligh	nt test		№82-13835
	182-13856	The influence of closed-coupled, rear fusel mounted nacelles on the design of an adva	
BRVIRONMENT RPPECTS Transportation systems evaluation methodolog	34	high speed wing	N82-13092
development and applications, thase 3	102 42054	EXPLOSIONS	
[NASA-CR-164999] NEWVIRONBERT SIMULATION Helicopter 1cing	182-12051	Investigation of the structural degradation personnel hazards resulting from helicopt composite structures exposed to fires and	er
EQUIPMENT	182-13243		N82-12057
The impact of new guidance and control syste mulitary aircraft cockpit design	ens on	EXTERNAL STORES Prediction of aerodynamic loads on aircraft	s with
[AGARE-CP-312] NEQUIPMENT SPECIFICATIONS	182-13048	external stores at transonic speeds	
Practical aspects of instrumentation system installation, volume 13			N82-13813
[NASA-TM-84067]	182-13140	F F	
BRROR ANALYSIS Publishing confede of Affer in PARACEANS		P-4 AIRCRAFT	
Evaluating sources of error in EAR/GEANS navigation using a Kalman postprocessor Electronically Agile Badar/Gimbaled Electr suspended gyro Airborne Navigation System		P-4 Advanced Avionics Flight Test [AIAA FAPER 81-2464]	A 82-13929
	182-14739		

SUBJECT INDEX FEEDBACK CONTROL

P-14 AIRCRAPT	Investigation of severe lightning strike incidents
Pleet Plight Loads Survey monitoring and analys:	
techniques [AIAA PAPRE 81-2461] A82-	[NASA-CR-165794] N82-12052 13903 F+111 AIRCRAFT
Flight test experience with high-alpha control	Pave Bover Flight Test Program
system techniques on the P-14 airplane	[AIAA PAPER 81-2492] A82-14380
[AIAA PAPER 81-2505] A82-	13906 FAIL-SAFE SYSTEMS
Limited evaluation of an P-14A airplane utilizing	
an aileron-rudder interconnect control system	
the landing configuration [NASA-TM-81972] N82-	[AIAA 81-2278] A82-13490 13148 General purpose real-time interaction panel for
F-15 AIRCRAPT	digital simulation of flight control systems
The use of separated multifunction inertial	A82-14831
sensors for flight control	PAILURE ANALYSIS
	13502 Pault detection for two physically separated,
Redundancy management of skewed and dispersed	communicating inertial measurement units A82-13142
inertial sensors [AIAA 81-2296] A82-	13503 Theoretical analysis of wake-induced parachute
Enhanced F-15 air-to-ground flight demonstration	· · · · · · · · · · · · · · · · · · ·
	13854 [AIAA PAPER 81-1922] A82-13963
Fighters - Improving the breed	A failure detection and isolation system for
	14354 tactical aircraft with separated IMUs
Status and tracking system for flight test data products	A82-14684 Pailure analysis of variable reluctance stepper
	14376 motor in electronic fuel control system on
A methodology for missile launch envelope displ	
evaluation	A82-14792
	14744 PAIRINGS
Assessing pilot workload - Without disturbing	Techniques for modifying airfoils and fairings on
pilot behavior	aircraft using foam and fiberglass 14745
F-15 SAR	14745 [AIAA PAPER 81-2445] A82-14383 PAN BLADES
* '- '-	14938 Thrust modulation methods for a subsonic V/SIOL
P-16 AIRCRAFT	aircraft
Digital redesign of existing multiloop continuo	
control systems with application to YF-16	
aircraft flight controller	Patigue methodology - A technical management 13093 system for helicopter safety and durability
The P-16/79 test program	13093 system for helicopter safety and durability A82-13240
	13855 Plight trail of the Aircraft Patigue Data Analysis
Fighters - Improving the breed	System (APDAS) Mk 2 prototype
A82-	14354 [AD-A105270] N82-12066
Advanced fighter technology integration AFTI/F-	
test program overview [AIAA PAPER 81-2353] A82-	Creep and aero gas turbine design 14398 A82-12987
The design and implementation of a canned scena	· · · · · · · · · · · · · · · · · · ·
function for the F-16 dynamic system simulato	
	14678 [AIAA FAPER 81-2434] A82-13872
Design of direct digital flight-mode control	Effect of fighter attack spectrum on composite
systems for high-performance aircraft	fatigue life 14829
An investigation of F-16 nozzle-afterbody force	(
at transonic Mach numbers with emphasis on mo	
scale effects	communicating inertial measurement units
[12392 882-13142
P-18 AIRCRAFT	Fault isolation methodology for the L-1011 digital
P/A-18A weapon system - 1976 state of the art	avionic flight control system 13453 [AIAA 81-2223] A82-13458
[AIAA 81-2215] A82- P/A-18 'Hornet' - One man operability	13453 [AIAA 81-2223] A82-13458 Computer-in-control selection logic for a triplex
	13484 digital flight control system
Avionics systems simulation for the Northrop	[AĪAA 81-2236] A82-13465
F/A-18L aircraft	The SIFT computer and its development Software
	13488 Implemented Fault Tolerance for aircraft control [AIAA 81-2278] A82-13490
P/A-18 high authority/high gain digital flight	<u> </u>
control system development and flight testing [AIAA PAPER 81-2465] A82-	13930 tactical aircraft with separated IMUs
P/A-18 Flight Test program overview - 1 Septemb	
1981	FEASIBILITY AWALYSIS
	13955 Implementing the DAIS executive Digital
The Mavy P/A-18A Hornet electromagnetic	Avionics Information System software feasibility
compatibility program	for aircraft systems 14760 A82-14814
P/A-18A high angle of attack/spin testing	Transportation systems evaluation methodology
	14934 development and applications, phase 3
P/A-18 roll rate improvement program	[NASA-CR-164999] N82-12051
	14939 FEEDBACK CONTROL
Testing of the SJU-5A ejection seat for the F/A /HOENET/ aircraft	1-18 A dual input actuator for fluidic backup flight control
	14955 182-13088
P/A 18 Hornet crew station	Digital redesign of existing multiloop continuous
	13064 control systems with application to YF-16
F-106 AIRCRAFT	aircraft flight controller
Thunderstorm hazards flight research - Program	A82-13093
OVERVIEW (ATAA DADDE 01_2012) A92-	Comparison between the exact and an approximate 13853 feedback solution for medium range interception
[AIAA PAPER 81-2412] A82- Operational evaluation of thunderstorm penetrat	
test flights during project Storm Bazards '80	A82-13106
	14954

FIBER OPTICS SUBJECT INDEX

The design of exact nonlinear model followers with application to trajectory autopilot for	Robust flight control - A design example A02-15845
helicopter	Aerodynamics of Power Plant Installation
A82-13125	[AGARD-CP-301] N82-13065
The use of observers on relaxed static stability	Performance of highly integrated inlets for
aircraft	supersonic aircraft
A82-14740 A synthesis technique for highly uncertain and	N82-13066
interacting multivariable flight control systems	Some RAE research on shielded and unshielded fuselage mounted air intakes at subsonic and
A82-14827	supersonic speeds
Acceptance testing of the Calspan variable	N82-13068
stability Learjet	Prediction and measurement of time-variant,
182-14937	three-dimensional flows in military aircraft
Experimental and analytical studies of advanced air cushion landing systems	intakes N82-13069
[NASA-CR-3476] N82-12065	The subscnic performance of practical military
Computational methods of robust controller design	variable area convergent nozzles
for aerodynamic flutter suppression	N82-13076
[NASA-CR-164983] N82-12080	Final report on the FueFo-4 major theme:
IBER OPTICS Advanced fiber optic systems for avicnics	Interference drag with airframe/engine
applications	integration on fighter aircraft [BMVG-FBWT-79-20] N82-13116
[AIAA 81-2319] A82-13518	Maneuver load control for the reduction of design
Piber-optic immunity to EMI/EMP for military	loads and improvement of the maneuverability of
aircraft	modern fighter aircraft
[AIAA 81-2339] A82-13529	[BHVG-FBWT-81-2] N82-13138
Portable air driven variable speed fiber optic cable termination polisher	FINITE DIFFERENCE THEORY
[AD-A104797] N82-12448	Calculation of wing-body-nacelle interference in subsonic and transonic potential flow
IRLD OF VIEW	N82-13095
The LANTIRN wide field-cf-view raster Head-Op	Numerical analysis of the scramjet-inlet flow
Display Low Altitude Navigation and	field by using two-dimensional Navier-Stokes
Targeting IR for Night A82-14825	equations
IGHTER AIRCRAFT	[NASA-TP-1940] N82-13142 PINITE VOLUME METHOD
Air-to-air combat analysis - Review of	Remarks on the calculation of transonic potential
differential-gaming approaches	flow by a finite volume method
A82-13115	A82-15835
Wing/store flutter - An active adaptive control	FIRE CONTROL
application A82-13122	Design and analysis of a digitally controlled
Fault detection for two physically separated,	integrated flight/fire control system [AIAA 81-2245] A82-13470
communicating inertial measurement units	Evaluation of advanced air-to-air gunnery fire
A82-13142	control systems
Avionics implications from wearon system	A82+14750
operational utility studies on Manned Air Combat Simulators	PIRE EXTINGUISHERS
[AIAA 81-2230] A82-13463	Fire extinguishant materials [NASA-CASE-ARC-11252-1] N82-12168
Application of the concept of dynamic trim control	Development and testing of dry chemicals in
and nonlinear system inverses to automatic	advanced extinguishing systems for jet engine
control of a vertical attitude takeoff and	nacelle fires
landing aircraft [AIAA 81-2238] A82-13466	[NASA-CE-165011] N82-13180 PIRE PIGHTING
Joint Tactical Microwave Landing System /JTMLS/	Flight testing the suspended maneuvering system
airborne signal processing	helicopter firefighting and rescue techniques
[AIAA 81-2247] A82-13471	[AIAA PAPER 81-2498] A82-13922
An update of an integrated CNI system - TIES	PIRES
Communication, Navigation, and Identification provided by Tactical Information Exchange System	Investigation of the structural degradation and
[AIAA 81-2292] A82-13500	personnel hazards resulting from helicopter composite structures exposed to fires and/or
Time-referencing of data in an asynchronous	explosions
environment for fighter aircraft avionics	[AD-A104757] N82-12057
[AIAA 81-2341] A82-13531	PIXED DINGS
The development of cryogenic wind tunnels and their application to maneuvering aircraft	Wing design for light transport aircraft with
technology	improved fuel economy A82-14410
A82-13971	Crashworthy military passenger seat development
Techniques for modifying airfoils and fairings on	A82-14976
alroraft using foam and fiberglass	FLAME RETARDABTS
[AIAA PAPER 81-2445] A failure detection and isclation system for	Formulation and characterization of polyimide
tactical aircraft with separated IMUs	resilient fcams of various densities for aircraft seating applications
A82-14684	[NASA-CR-167421] N82-12230
Will power-by-wire replace power-by-bydraulics	PLAPS (CONTROL SURPACES)
A82-14707	Navy spin evaluation of the A-7 airplane
Integrated Flight/Weapon Control design and evaluation	configured with automatic maneuvering flaps
evaluation A82-14741	PLAT PLATES A 82-14933
The influence of smart computers on the cockpit of	Turbulent wake development behind streamlined hodie:
the future	182-1310
A82-14743	PLEXIBLE BODIES
Evaluation of advanced air-to-air gunnery fire	Digital control for flexible aircraft using
control systems A82-14750	reduced order models A82-1309
Airborne color CRT displays	#odeling procedures for handling qualities
B82-14823	evaluation of flexible aircraft
A synthesis technique for highly uncertain and	A82-1396
interacting multivariable flight control systems	
A82-14827	

SUBJECT INDEX PLIGHT PATHS

PLIGHT ALTITUDE		USBTPS spin program	
On-line optimization of aircraft altitude a	nd		A82-14931
flight path angle dynamics	A82-13107	Robust flight control - A design example	A82-15845
PLIGHT CHARACTERISTICS		Fixed gain controller design for aircraft	
A decoupled control system for improved fli	ght	[AD-A104877]	N82-12081
performance in wind shear	A82-13079	Limited evaluation of an F-14A airplane ut an aileron-rudder interconnect control s	
Government testing	802-13073	the landing configuration	lacem In
	A82-13877	[NASA-TH-81972]	N82-13148
Selected stability and control derivatives	from	Interactive aircraft flight control and	
the first Space Shuttle entry [AIAA PAPER 81-2451]	A82-13880	<pre>aeroelastic stabilization forward swe flight vehicles</pre>	ept wing
Powered-lift STGL aircraft shipboard operat		[NASA-CR-165036]	N82-13150
A comparison of simulation, land-based an		LIGHT CREWS	
trial results for the QSRA Quiet Shor	t-haul	High-accuracy ranging over voice radios for	c downed
Besearch Aircraft [AIAA PAPEE 81-2480]	A82-13938	aircrew rescue	A82-14694
AD-1 oblique wing aircraft program	802-13330	Rescue at sea	H02-14034
[AIAA PAPER 81-2354]	A82-14390		A82-14956
PLIGHT CLOTHING		'Little people' problem /MA-2 torso harnes:	
Evaluation of a selected group of anti-expo garment configurations for their effects		A new safety barness for mobile aircrew	A82-14958
operational performance and survival of N		a dea parec' nathena for montre diferen	A82-14963
aircrewmen		Evaluation of a selected group of anti-exp	
	A82-14972	garment configurations for their effects	
A decoupled control system for improved fli	aht	operational performance and survival of laircreamen	NgAgi
performance in wind shear	.yarc	drect camen	A82-14972
	A82-13079	Test and evaluation of improved aircrew re-	straint
A dual input actuator for fluidic tackup fl Control	.ight	systems	A82-14974
· 	A82-13088	HASEP - Survival from crashed Navy helicopy	
Fault detection for two physically separate		made buttered from ordered from a formation of	A82-14977
communicating inertial measurement units		Analytical and experimental characterization	
	A82-13142	the JAU-14/A cartridge actuated initiato	
Integrated avionics - Concepts and concerns [AIAA 81-2211]	A82-13452	use in aircrew escape system performance evaluation	
Digital avionics - What a pilot expects to		***************************************	A82-14985
[AIAA 81-2217]	A82-13455	Tanker avionics and aircrew complement eval	
The role of avionics in the all electric ai [AIAA 81-2219]	.rplane 182-13457	F/A 18 Hornet crew station	N82-13063
Pault isolation methodology for the L-1011		1/a to normer cles station	N82-13064
avionic flight control system	_	Group 1: Scenario design and development	
	A82-13458	TOUR GARANCE	N82-13131
Computer-in-control selection logic for a t digital flight control system	riplex	LIGHT HAZARDS Thunderstorm bazards flight research - Pro-	ram
	A82-13465	Overview	,
Design and analysis of a digitally controll	.ed	[AIAA FAPER 81-2412]	A82-13853
integrated flight/fire control system	A82-13470	Direct strike lightning measurement system aircraft	for
The use of separated multifunction inertial		[AIAA PAPER 81-2513]	A82-13910
-sensors for flight control		PLIGHT INSTRUMENTS	
([AIAA 81-2295]	A82-13502	Software considerations in the design of c	omputer
Redundancy management of skewed and dispers inertial sensors	sed	generated flight displays	A82-14742
[AIAA 81-2296]	A82-13503 I	PLIGHT LOAD RECORDERS	2022
Development and laboratory test of an integ		Fleet Flight loads Survey monitoring and a	nalysıs
sensory system /ISS/ for advanced aircraft	t 4350"	techniques	A82-13903
[AIAA 81-2297] Enhanced F-15 air-to-ground flight demonstr	A82-13504	[AIAA PAPER 81-2461] Comparison of wind tunnel and theoretical	M02-13503
[AIAA PAPER 81-2413]	A82-13854	aeroelastic predictions with flight meas	nreg -
Plight experience with a remotely augmented	l	airloads for the B-1 aircraft	
Vehicle flight test technique	100 100F7 1	[AIAA PAPEE 81-2387] PLIGHT OPERATIONS	A82-14393
[AIAA PAPES 81-2417] A cost effective method for the control of		The influence of wind shear and Vertical w	inds on
due to side slip on a low speed aircraft	1011	takeoffs and go-arounds	
[AIAA PAPES 81-2422]	A82-13861		A82-15823
F/A-18 high authority/high gain digital fla control system development and flight tes	· y - ·	PLIGHT OPTIMIZATION Real-time flight management avionics softw	are system
(AIAA PAPER 81-2465)	A82-13930	[AIAA 81-2340]	A82-13530
Comparison of low-speed handling qualities		Flight management systems for modern jet a	ırcraft
ground-based and in-flight simulator test		li-li	A82-14778
[AIAA PAPER 81-2478] Experience with flight test trajectory guid	≱82-13936 lance	Airplane performance sensitivities to late vertical profiles	TOT ONO
[AIAA PAPER 81-2504]	A82-14379		A82-15846
Navigation for helicopters by multiple use	of 1	PLIGHT PATHS	
inertial sensors	107-18713	Darboux points in minimum-fuel aircraft la	naing
Evaluation of advanced air-to-air gunnery f	∆82-14713 fire	problems	A82-13077
control systems		On-line optimization of aircraft altitude	
	A82-14750	flight path angle dynamics	
Passive terrain following using stored map	and	Computergraphics for aircraft control	A82-13107
global positioning system	A82-14772	[AIAA 81-2313]	A82-13515
Design of direct digital flight-mode contro		Development of an MLS lateral autoland sys	tem with
systems for high-performance aircraft	.00 40000	automatic path definition	A82-13993
	∆82-14829	[AIAA FAPER 81-1751]	DUZ-13333

PLIGHT SAPETY SUBJECT INDEX

The Managering Plickt Dath Display - 1 flight	ml C
The Maneuvering Flight Path Display - A flight	The use of separated multifunction inertial
trajectory solution display concept	sensors for flight control
182-14824	[AIAA 81-2295] A82-13502
Application of singular perturbation theory	Design and flight test of a lateral-directional
N82-12050	command augmentation system
PLIGHT SAFBTY	[AIAA 81-2331] A82-13527
Safety of helicopters in flight Bussian book	Powered-lift takeoff performance characteristics
A82-14946	determined from flight test of the Quiet
A new safety harness for mobile aircrew	Short-haul Research Alicraft /QSRA/
A82-14963	
Computer Air Carrier Symposium	Enhanced F-15 air-to-ground flight demonstrations
[AD-A104894] N82-12054	[AIAA PAPER 81-2413] A82-13854
Summary of Federal Aviation Administration	The F-16/79 test program
responses to National Transportation Safety	[AIAA PAPER 81-2414] A82-13855
Board safety recommendations	Organizing and training for innovative flight test
[AD-A104922] N82-12055	management
Orienting description of air traffic control in	[AIAA PAPER 81-2416] A82-13856
the Netherlands	Plight experience with a remotely augmented
[VTH-LR-285] N82-12063	
	vehicle flight test technique [AIAA PAPER 81-2417] A82-13857
PLIGHT SINULATION	
Avionics implications from wearon system	A technique to determine lift and drag polars in
operational utility studies on Manned Air Combat	flight and their application
Simulators	[AIAA FAPER 81-2420] A82-13859
[AIAA 81-2230] A82-13463	Navy performance modeling techniques
Avionics systems simulation for the Northrop	[AIAA PAPER 81-2431] A82-13869
F/A-18L aircraft	HimaT aerodynamic design and flight test experience
[AIAA 81-2274] A82-13488	[AIAA PAPER 81-2433] A82-13871
The need for, and development of, a simulation	
	Advancing blade concept /ABC/ development test
facility at the Naval Air Test Center	Program
[AIAA PAPER 81-2488] A82-13917	[AIAA PAPER 81-2437] A82-13873
Powered-lift S10L aircraft shipboard operations -	Recent propulsion system flight tests at the NASA
A comparison of simulation, land-tased and sea	Dryden Flight Research Center
trial results for the QSRA Quiet Short-haul	[AIAA FAPER 81-2438] A82-13874
Besearch Aircraft	The Cessna T303 Crusader
[AIAA PAPER 81-2480] A82-13938	[AIAA FAPER 81-2440] A82-13876
Jet V/STOL wind-tunnel simulation and groundplane	Government testing
effects	[AIAA PAPER 81-2443] A82-13877
A82-13973	
A review of flight-to-wind tunnel drag correlation	Flight test method for the determination of
	reciprocating engine cooling requirements
[AIAA PAPER 81-2475] A82-14382	[AIAA PAPER 81-2446] A82-13878
Evaluating sources of error in EAR/GEANS	Planning a helicopter flight test program
navigation using a Kalman postprocessor	[AIAA PAPER 81-2381] A82-13881
Electronically Agile Eadar/Gimbaled Electrically	Recent improvements at the Naval Air Test Center
suspended gyro Airborne Navigation System	for increased test system flexibility
A82-14739	[AIAA PAPER 81-2392] A82-13888
General purpose real-time interaction panel for	Plight testing the nonmetallic spline coupling
digital simulation of flight control systems	technology at the Naval Air Test Center
· A82-14831	
Inverse SAR and its application to aircraft	Information technology and its impact on test and
classification	evaluation at the Naval Air Test Center
A82-14871	[AIAA PAPER 81-2396] A82-13894
Computer image generation for flight simulation	Georgia Tech coherent jammer flight test
A82-15599	[AIAA PAPER 81-2452] A82-13898
The effect of visual information on manual	Pleet Flight loads Survey monitoring and analysis
approach and landing	techniques
[NLB-MP-80019-U] N82-12064	[AIAA PAPER 81-2461] A82-13903
Use of a helmet-mounted matrix display for	Flight test experience with high-alpha control
presenting energy-maneuverability information	
	system techniques on the F-14 airplane
during simulated close combat	[AIAA PAPER 81-2505] A82-13906
N82-13061	Flight testing De Havilland Aircraft Limited
PLIGHT SIMULATORS	
	DASH-8 utilizing onboard data analysis by
Low cost programmable multisimulator facility	microprocessor
[AIAA 81-2229] A82-13534	microprocessor [AIAA PAPER 81-2507] A82-13907
[AIAA 81-2229] A82-13534 Commentary on facilities used in the development	microprocessor
[AIAA 81-2229] A82-13534	microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit
[AIAA 81-2229] Commentary on facilities used in the develorment of a Sea Harrier all weather operations capability [AIAA PAPBE 81-2407] A82-13892	microprocessor [AIAA PAPER 81-2507] A82-13907
[AIAA 81-2229] Commentary on facilities used in the develorment of a Sea Harrier all weather operations capability [AIAA PAPBE 81-2407] A82-13892	microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPBE 81-2407] A82-13892 Comparison of low-speed handling qualities in	microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAPER 81-2510] A82-13908
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPBE 81-2407] Comparison of low-speed handling qualities in ground-based and in-flight simulator tests	microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A82-13908 Instrumentation to determine the suitability of
[AIAA 81-2229] Commentary on facilities used in the develorment of a Sea Harrier all weather operations capability [AIAA PAPER 81-2407] Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPER 81-2478] A82-13936	microprocessor (AIAA PAPER 81-2507) Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAFER 81-2510] Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPBE 81-2407] Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPBE 81-2478] The design and inflementation of a canned scenario	microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAPER 81-2510] Instrumentation to determine the suitability of BNAV systems for helicopter navigation in the national airspace system /NAS/
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPEE 81-2407] A82-13892 Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPEE 81-2478] The design and implementation of a canned scenario function for the P-16 dynamic system simulator	microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAPER 81-2510] A82-13908 Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA FAPER 81-2514] A82-13911
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPEB 81-2407] Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPEB 81-2478] A82-13936 The design and implementation of a canned scenario function for the P-16 dynamic system simulator A82-14678	Interprocessor (AIAA PAPER 81-2507) Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAPER 81-2510] A82-13908 Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA FAPER 81-2514] A82-13911 The Air Force Flight Test Center - Utah Test and
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPER 81-2407] Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPER 81-2478] The design and implementation of a canned scenario function for the P-16 dynamic system simulator A real time Fegasus propulsion system model for	microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A82-13908 Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA PAPER 81-2514] A82-13911 The Air Force Plight Test Center - Utah Test and Training Range in the 1980's
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPBE 81-2407] Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPBE 81-2478] The design and implementation of a canned scenario function for the P-16 dynamic system simulator A82-14678 A real time Fegasus propulsion system model for VSTOL piloted simulation evaluation	microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAPER 81-2510] A82-13908 Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA FAPER 81-2514] A82-13911 The Air Force Flight Test Center - Utah Test and Training Range in the 1980's [AIAA FAPER 81-2487] A82-13916
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPEE 81-2407] Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPEE 81-2478] The design and implementation of a canned scenario function for the P-16 dynamic system simulator A82-14678 A real time Fegasus propulsion system model for VSTOL piloted simulation evaluation [NASA-TM-82770] N82-13144	microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAPEE 81-2510] A82-13908 Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA FAPER 81-2514] A82-13911 The Air Force Flight Test Center - Utah Test and Training Range in the 1980's [AIAA FAPER 81-2487] A82-13916 The need for, and development of, a simulation
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPER 81-2407] Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPER 81-2478] The design and implementation of a canned scenario function for the P-16 dynamic system simulator A real time Fegasus propulsion system model for VSTOL piloted simulation evaluation [NASA-TM-82770] PLIGHT TEST INSTRUMENTS	Interprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAPER 81-2510] Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA FAPER 81-2514] The Air Force Flight Test Center - Utah Test and Training Range in the 1980's [AIAA FAPER 81-2487] The need for, and development of, a simulation facility at the Naval Air Test Center
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPER 81-2407] Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPER 81-2478] The design and implementation of a canned scenario function for the P-16 dynamic system simulator A real time Fegasus propulsion system model for VSTOL piloted simulation evaluation [NASA-TM-82770] PLIGHT TEST INSTRUMENTS	microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAPEE 81-2510] A82-13908 Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA FAPER 81-2514] A82-13911 The Air Force Flight Test Center - Utah Test and Training Range in the 1980's [AIAA FAPER 81-2487] A82-13916 The need for, and development of, a simulation
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPEE 81-2407] Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPEE 81-2478] The design and implementation of a canned scenario function for the P-16 dynamic system simulator A82-14678 A real time Fegasus propulsion system model for VSTOL piloted simulation evaluation [NASA-TM-82770] N82-13144	microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A82-13908 Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA PAPER 81-2514] A82-13911 The Air Force Plight Test Center - Utah Test and Training Range in the 1980's [AIAA PAPER 81-2487] A82-13916 The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] A82-13917
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPBE 81-2407] A82-13892 Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPBE 81-2478] A82-13936 The design and implementation of a canned scenario function for the P-16 dynamic system simulator A82-14678 A real time Fegasus propulsion system model for VSTOL piloted simulation system model for INASA-TM-82770] PLIGHT TEST INSTRUMENTS Practical aspects of instrumentation system installation, volume 13	microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A82-13908 Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA PAPER 81-2514] A82-13911 The Air Force Plight Test Center - Utah Test and Training Range in the 1980's [AIAA PAPER 81-2487] A82-13916 The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] A unique integrated flight testing facility for
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPEE 81-2407] Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPEE 81-2478] The design and implementation of a canned scenario function for the P-16 dynamic system simulator A82-14678 A real time Fegasus propulsion system model for VSTOL piloted simulation evaluation [NASA-TM-82770] N82-13144 PLIGHT TEST INSTRUMENTS Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] N82-13140	Interprocessor (AIAA PAPER 81-2507) Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAPER 81-2510] A82-13908 Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA FAPER 81-2514] The Air Force Plight Test Center - Utah Test and Training Range in the 1980's [AIAA PAPER 81-2487] The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] A82-13917 Aunique integrated flight testing facility for advanced control/display research
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPER 81-2407] Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPER 81-2478] The design and implementation of a canned scenario function for the r-16 dynamic system simulator A real time Fegasus propulsion system model for VSTOL piloted simulation evaluation [NASA-TH-82770] PLIGHT TEST INSTRUMENTS Practical aspects of instrumentation system installation, volume 13 [NASA-TH-84067] N82-13140 PLIGHT TESTS	Interprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAPER 81-2510] Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA FAPER 81-2514] The Air Force Flight Test Center - Utah Test and Training Range in the 1980's [AIAA FAPER 81-2487] The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] A unique integrated flight testing facility for advanced control/display research [AIAA PAPER 81-2490] A 82-13919
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPBE 81-2407] A82-13892 Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPBE 81-2478] A82-13936 The design and implementation of a canned scenario function for the P-16 dynamic system simulator A82-14678 A real time Fegasus propulsion system model for VSTOL piloted simulation system model for VSTOL piloted simulation evaluation [NASA-TM-82770] PLIGHT TEST INSTRUMENTS Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] N82-13140 PLIGHT TESTS On matching the systems identification technique	microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A82-13908 Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA PAPER 81-2514] A82-13911 The Air Force Plight Test Center - Utah Test and Training Range in the 1980's [AIAA PAPER 81-2487] A82-13916 The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] A82-13917 A unique integrated flight testing facility for advanced control/display research [AIAA PAPER 81-2490] Flight testing the suspended maneuvering system
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPBE 81-2407] A82-13892 Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPBE 81-2478] The design and implementation of a canned scenario function for the P-16 dynamic system simulator A82-14678 A real time Fegasus propulsion system model for VSTOL piloted simulation evaluation [NASA-TH-82770] N82-13144 PLIGHT TEST INSTRUMENTS Practical aspects of instrumentation system installation, volume 13 [NASA-TH-84067] N82-13140 PLIGHT TESTS On matching the systems identification technique to the particular application in evaluating	Incroprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA PAPER 81-2514] The Air Force Plight Test Center - Utah Test and Training Range in the 1980's [AIAA PAPER 81-2487] The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] A unique integrated flight testing facility for advanced control/display research [AIAA PAPER 81-2490] A 82-13919 Flight testing the suspended maneuvering system helicopter fireflighting and rescue techniques
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPBE 81-2407] Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPBE 81-2478] The design and implementation of a canned scenario function for the P-16 dynamic system simulator A82-14678 A real time Fegasus propulsion system model for VSTOL piloted simulation evaluation [NASA-TM-82770] N82-13144 PLIGHT TEST INSTRUMENTS Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] N82-13140 PLIGHT TESTS On matching the systems identification technique to the particular application in evaluating flight test data	(AIAA PAPER 81-2507] A82-13907 Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAPER 81-2510] A82-13908 Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA FAPER 81-2514] A82-13911 The Air Force Flight Test Center - Utah Test and Training Range in the 1980's [AIAA PAPER 81-2487] A82-13916 The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] A82-13917 A unique integrated flight testing facility for advanced control/display research [AIAA PAPER 81-2490] Flight testing the suspended maneuvering system helicopter fireflighting and rescue techniques [AIAA FAPER 81-2498] A82-13922
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPER 81-2407] Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPER 81-2478] A82-13936 The design and implementation of a canned scenario function for the P-16 dynamic system simulator A82-14678 A real time Fegasus propulsion system model for VSTOL piloted simulation evaluation [NASA-TM-82770] PLIGHT TEST INSTRUMENTS Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] N82-13140 PLIGHT TESTS On matching the systems identification technique to the particular application in evaluating flight test data A82-13119	Interprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAPER 81-2510] Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA FAPER 81-2514] The Air Force Flight Test Center - Utah Test and Training Range in the 1980's [AIAA FAPER 81-2487] The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] Aunique integrated flight testing facility for advanced control/display research [AIAA PAPER 81-2490] Flight testing the suspended maneuvering system —— helicopter fireflighting and rescue techniques [AIAA FAPER 81-2498] A82-13922 Improved techniques for the calibration and
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPBE 81-2407] A82-13892 Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPBE 81-2478] A82-13936 The design and implementation of a canned scenario function for the P-16 dynamic system simulator A82-14678 A real time Fegasus propulsion system model for VSTOL piloted simulation system model for VSTOL piloted simulation evaluation [NASA-TM-82770] PLIGHT TEST INSTRUMENTS Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] N82-13140 PLIGHT TESTS On matching the systems identification technique to the particular application in evaluating flight test data A82-13119 Determining hinge moments and empennage airload	Incroprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA PAPER 81-2514] A82-13911 The Air Force Plight Test Center - Utah Test and Training Range in the 1980's [AIAA PAPER 81-2487] The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] A82-13917 A unique integrated flight testing facility for advanced control/display research [AIAA PAPER 81-2490] Flight testing the suspended maneuvering system helicopter fireflighting and rescue techniques [AIAA PAPER 81-2498] A82-13922 Improved techniques for the calibration and measurement of in-flight loads
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPBE 81-2407] A82-13892 Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPBE 81-2478] A82-13936 The design and implementation of a canned scenario function for the P-16 dynamic system simulator A82-14678 A real time Fegasus propulsion system model for VSTOL piloted simulation evaluation [NASA-TM-82770] N82-13144 PLIGHT TEST INSTRUMENTS Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] N82-13140 PLIGHT TESTS On matching the systems identification technique to the particular application in evaluating flight test data A82-13119 Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes	Incroprocessor (AIAA PAPER 81-2507) Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAPER 81-2510] A82-13908 Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA FAPER 81-2514] A82-13911 The Air Force Plight Test Center - Utah Test and Training Range in the 1980's [AIAA FAPER 81-2487] A82-13916 The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] A82-13917 A unique integrated flight testing facility for advanced control/display research [AIAA FAPER 81-2490] A82-13919 Flight testing the suspended maneuvering system helicopter firefighting and rescue techniques [AIAA FAPER 81-2498] A82-13922 Improved techniques for the calibration and measurement of in-flight loads [AIAA PAPER 81-2502] A82-13924
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPER 81-2407] Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPER 81-2478] A82-13936 The design and implementation of a canned scenario function for the P-16 dynamic system simulator A82-14678 A real time Fegasus propulsion system model for VSTOL piloted simulation evaluation [NASA-TH-82770] PLIGHT TEST INSTRUMENTS Practical aspects of instrumentation system installation, volume 13 [NASA-TH-84067] N82-13140 PLIGHT TESTS On matching the systems identification technique to the particular application in evaluating flight test data A82-13119 Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120	Incroprocessor (AIAA PAPER 81-2507) Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAPER 81-2510] Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA FAPER 81-2514] The Air Force Flight Test Center - Utah Test and Training Range in the 1980's [AIAA FAPER 81-2487] The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] Aunique integrated flight testing facility for advanced control/display research [AIAA PAPER 81-2490] Flight testing the suspended maneuvering system helicopter firefighting and rescue techniques [AIAA FAPER 81-2498] Improved techniques for the calibration and measurement of in-flight loads [AIAA PAPER 81-2502] Overview of flight and ground testing with
[AIAA 81-2229] Commentary on facilities used in the development of a Sea Harrier all weather operations capability [AIAA PAPBE 81-2407] A82-13892 Comparison of low-speed handling qualities in ground-based and in-flight simulator tests [AIAA PAPBE 81-2478] A82-13936 The design and implementation of a canned scenario function for the P-16 dynamic system simulator A82-14678 A real time Fegasus propulsion system model for VSTOL piloted simulation evaluation [NASA-TM-82770] N82-13144 PLIGHT TEST INSTRUMENTS Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] N82-13140 PLIGHT TESTS On matching the systems identification technique to the particular application in evaluating flight test data A82-13119 Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes	Incroprocessor (AIAA PAPER 81-2507) Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA FAPER 81-2510] A82-13908 Instrumentation to determine the suitability of ENAV systems for helicopter navigation in the national airspace system /NAS/ [AIAA FAPER 81-2514] A82-13911 The Air Force Plight Test Center - Utah Test and Training Range in the 1980's [AIAA FAPER 81-2487] A82-13916 The need for, and development of, a simulation facility at the Naval Air Test Center [AIAA PAPER 81-2488] A82-13917 A unique integrated flight testing facility for advanced control/display research [AIAA FAPER 81-2490] A82-13919 Flight testing the suspended maneuvering system helicopter firefighting and rescue techniques [AIAA FAPER 81-2498] A82-13922 Improved techniques for the calibration and measurement of in-flight loads [AIAA PAPER 81-2502] A82-13924

SUBJECT INDEX

F-4 Advanced Avionics Flight Test [AIAA PAPER 81-2464] A82-13929	F/A-18A high angle of attack/spin testing A82-14934
P/A-18 high authority/high gain digital flight control system development and flight testing	KC-10 flight test program A82-14935
[AIAA PAPER 81-2465] A82-13930	The all composite Lear Fan 2100
The development and flight test evaluation of an integrated propulsion control system for the HiMAT research airplane	A82-14936 Acceptance testing of the Calspan variable stability Learjet
[AIAA PAPER 81-2467] A82-13931	A82-14937
Comparison of low-speed handling qualities in ground-based and in-flight simulator tests	F/A-18 roll rate improvement program A82-14939
[AIAA PAPER 81-2478] A82-13936 Powered-lift STOL aircraft shipboard operations -	AV-8B technical update - Leading edge root extension development
A comparison of simulation, land-based and sea	A82-14940
trial results for the QSBA Quiet Short-haul Research Aircraft	Operational evaluation of thunderstorm penetration test flights during project Storm Hazards '80
[AIAA PAPEE 81-2480] Two at a time - Flight test plans for the new	A82-14954 Direct free-flight analysis of aircraft dynamics
Boeing airliners	at high angles of attack A82-15596
Plight test concept evolution	Flight trail of the Aircraft Patigue Data Analysis
[AIAA PAPES 81-2375] The development and use of a computer-interactive	System (AFCAS) Mk 2 prototype [AD-A105270] N82-12066
data acquisition and display system in a flight environment	PLIGHT TIME Electronic master monitor and advisory display
[AIAA PAPER 81-2371] A82-13946	system test and demonstration report
Automatic digital gain ranging for flight test telemetry data	[AD-A105317] N82-13141 PLIGHT TRAINING
[AIAA PAPER 81-2370] A82-13947	Group 1: Scenario design and development issues N82-13131
F/A-18 Flight Test program overview ~ 1 September 1981	FLOQUET THEOREM
[AIAA PAPEE 81-2351] A82-13955 Navstar Global Positioning System flight test	Application of the ONERA dynamic stall model to a helicopter blade in forward flight
program overview [AIAA PAPEE 81-2350] A82-13956	[CNEEA, TP NO. 1981-89] A82-13992 PLOW CHARACTERISTICS
Development of a lifting parachute to provide	The influence of closed-coupled, rear fuselage
self-dispersing capability for an Avco-designed tactical munition	mounted nacelles on the design of an advanced high speed wing
[AIAA PAPER 81-1928] Status and tracking system for flight test data	PLOW DISTRIBUTION
products	A large-scale investigation of engine influence on
[AIAA PAPER 81-2395] A82-14376 An advanced facility for processing aircraft	inlet performance at angle-of-attack [AIAA PAPER 81-2481] A82-13939
dynamic test data [AIAA PAPEE 81-2398] A82-14377	Experimental investigation of total pressure loss and airflow distribution for gas turbine
Experience with flight test trajectory guidance	combustors
[AIAA PAPER 81-2504] A62-14379 Pave Mover Flight Test Frogram	A82-15606 The numerical solution of incompressible turbulent
[AIAA PAPER 81-2492] A82-14380 In-flight deflection measurement of the HiMAT	flow over airfoils N82-12030
aeroelastically tailored wing	Subsonic military aircraft engine intake: An
[AIAA PAPEE 81-2450] A82-14381 KC-10; flight test program management - The	integrated theoretical experiment design N82-13073
contractor's viewpoint [AIAA PAPEE 81-2380] A82-14384	Model testing techniques for measuring inlet drag N82-13084
62% manned aircraft demonstrator - Next generation	The role and implementation of different
trainer cost effective pilot trainer [AIAA PAPEE 81-2519] A82-14385	nacelle/engine simulation concepts for wind-tunnel testing in research and development
Hover tests of the XV-15 Tilt Botor Research Aircraft	work on transport aircraft N82-13086
[AIAA PAPER 81-2501] A82-14386 Testing capabilities of the 3246th Test Wing	Numerical analysis of the scramjet-inlet flow field by using two-dimensional Navier-Stokes
[AIAA PAPBE 81-2484] A82-14387	equations
Integrated flight testing based on monlinear system identification data processing techniques	[NASA-TF-1940] N82-13142 PLOW EQUATIONS
[AIAA PAPER 81-2449] Applications of covariance analysis simulation to	Prediction and measurement of time-variant, three-dimensional flows in military aircraft
avionics flight testing	intakes
A82-14767 Flight management systems for modern jet aircraft	PLOW MEASUREMENT
A82-14778 The X-14 - 24 years of V/STCL flight testing	Prediction and measurement of time-variant, three-dimensional flows in military aircraft
Ball-Bartoe Jetwing flight tests	intakes 82-13069
A82-14928 Plight investigations of integrated descent rate	Prop-fan integration at cruise speeds 882-13097
control systems	PLOW THEORY
Progress report - CB-47 modernization program	Prop-fan integration at cruise speeds
M82-14930 USNTPS spin grogram	PLUIDIC CIRCUITS A dual input actuator for fluidic backup flight
A82-14931 The USAF Test Pilot School high angle of attack	control A82-13088
and spin training program	PLOTTER
A82-14932 Bavy spin evaluation of the A-7 airplane	Trim tab excitation system for the BAe 146 A82-14363
configured with automatic maneuvering flaps A82-14933	Experimental and analytical studies of advanced air cushion landing systems
	[NASA-CR-3476] N82-12065

PLUTTER ABALTSIS SUBJECT INDEX

Design for active and passive flutter suppression and gust alleviation	n CT7 - GE attacks commuter turboprop market A82-	1505/
[NASA-CR-3482] N82-1		1333
PLUTTER ABALYSIS	Quality optimization and unification of aviation	n
Wing/store flutter - An active adaptive control application	gasolines	1577
A82-1	A82- 3122 FUBL-AIR RATIO	1372
Plight vibration optimization via conformal mapp	ing Effect of fuel-air-ratio nonuniformity on	
A82-1 Aeroelasticity matters: Some reflections on two		4244
decades of testing in the NASA Langley transon		13 14.
dynamics tunnel	F/A-18 roll rate improvement program	
[NASA-TM-83210] N82-1 Computational methods of robust controller designment		14939
for aerodynamic flutter suppression	PUSELAGES A recursive time domain analysis of distributed	
[NASA-CR-164983] N82-1	2080 line grid networks with application to the	
Interactive aircraft flight control and aeroelastic stabilization forward swept wi	LTA/EMP problem Lightning Threat Analysis	
flight vehicles	ng Some RAE research on shielded and unshielded	14 76
[NASA-CR-165036] N82-1		
PLY BY WIRE CONTROL A dual input actuator for fluidic tackup flight	superscnic speeds	12066
control	N82- The influence of closed-coupled, rear fuselage	13000
A82-1	3088 mounted nacelles on the design of an advanced	
Direct digital drive actuation [AIAA 81-2298] A82-1	high speed wing	1200
Reliability analysis of the F-8 digital	3505 N82- Aerodynamic aspects of a high bypass ratio engil	
fly-by-wire system	installation on a fuselage afterbody	
[NASA-CR-163110] N82-1	2079 N82-	13093
Techniques for modifying airfoils and fairings o	n o	
aircraft using fcam and fiberglass	G	
[AIAA PAPER 81-2445] Pormulation and characterization of polyimide	4383 GAME THEORY Air-to-air combat analysis - Review of	
resilient foams of various densities for	differential-gaming approaches	
aircraft seating applications	A82-	13 1 15
[NASA-CR-167421] N82-1 PREE PLIGHT TEST APPARATUS	2230 GARMENTS Evaluation of a selected group of anti-exposure	
Direct free-flight analysis of aircraft dynamics		
at high angles of attack	operational performance and survival of Naval	
PREQUENCY RESPONSE	5596 aircrewnen A82-	14973
The use of frequency methods in rotorcraft syste		
identification [AIAA PAPEE 81-2386] A82-1	Divergence of a sweptforward wing	12566
FREQUENCY SYNTHESIZERS	4392 A82-	13300
High speed microwave phase-locked loops	Creep and aero gas turpine design	
PRICTION DRAG	4696 A82- Study of the load-carrying capacity of aviation	
A review of flight-to-wind tunnel drag correlati	on gas-turbine engine impellers under low-cycle	
[AIAA PAPER 81-2475] A82-1	4382 loading at normal and high temperatures	
Chemistry of combustion of fuel-water mixtures	A82-: Experimental investigation of total pressure los	
[AD-A105401] N82-1	2178 and airflow distribution for gas turbine	~~
Effect of fuel-air-ratio nonuniformity on emissions of nitrogen oxides	combustors	1500
[NASA-TP-1798] N82-1	A82- 3143 'In situ' composites for jet propulsion and	13600
PUBL CONSUMPTION	stationary gas turbine applications	
Darboux points in minimum-fuel aircraft landing problems	A82-	
- A82-1	Progress in protective coatings for aircraft gas 3077 turbines: A Review of NASA sponsored research	
Fuel efficient flight profiles in an ATC flow	[NASA-TM-82740] N82-	
management environment A82-1	GASOLINE 3078 Quality optimization and unification of aviation	n
An operational model of specific range for	gasolines	
microprocessor applications in piston-prop	A82-	1572
general aviation airplanes [AIAA 81-2330] A82-1	GEARS 3526 Vibration test procedures for accessory angle	
Real-time flight management avionics software sy		jet
[AIAA 81-2340] Performance assessment of an advanced reheated	3	12074
turbo fan engine	[AD-A105269] N82- GEBERAL AVIATION AIRCRAFT	1207
[AIAA PAPEE 81-2447] A82-1	3879 An operational model of specific range for	
Wing design for light transport aircraft with improved fuel economy	microprocessor applications in piston-prop	
A82-1	general aviation airplanes 4416 [AIAA 81-2330] A82-	13520
The all electric airplane - Its development and	Emergency in-flight egress for general aviation	
logistic support A82-1	alrcraft 4709 A82-	1495
Plight management systems for modern jet aircraf		
A82-1	4778 receiver	
Failure analysis of variable reluctance stepper motor in electronic fuel control system on	[AD-A104921] NASA research in aircraft propulsion	120ó
jet engine	[NASA-TM-82771] N82-	1314
A82-1	4792 GLASS FIBER REINFORCED PLASTICS	
Airplane performance sensitivities to lateral an vertical profiles	Techniques for modifying airfoils and fairings of aircraft using foam and fiberglass	OD
A82-1	5846 [AIAA PAPRE 81-2445] A82-	1438

GLIDIEG		A new safety barness for mobile aircrew	
A look at the Hoffman Triangular parachute	- The	-	A82-14963
first successful glidable parachute	A82-14966	Commentary on facilities used in the develo	nmen+
GLOBAL POSITIONIEG SYSTEM	A02-14300	of a Sea Harrier all weather operations c	
Navstar Global Positioning System flight to	est	[AIAA FAPEE 81-2407]	A82-13892
program overview	102-12056	AV-8B technical update - Leading edge root	
[AIAA PAPER 81-2350] Weapon delivery system using GPS	A82-13956	extension development	A82-14940
weater deriver of recor total of the	A82-14711	A real time Fegasus propulsion system model	
Passive terrain following using stored map	and	VSTOL piloted simulation evaluation	
global positioning system	A82-14772	[NASA-TM-82770] HAZARDS	N82-13144
GOVERNMENT/INDUSTRY RELATIONS	B02-14772	Investigation of the structural degradation	and
Government testing		personnel hazards resulting from helicopt	er
[AIAA PAPEE 81-2443]	A82-13877	composite structures exposed to fires and	/01
The payoff from U.S. investment in aeronautresearch and development	tical	explosions [AD-A104757]	N82-12057
research and development	A82-14793	BBAD-UP DISPLAYS	102 12057
GRAPHITE-BEOXY COMPOSITES		Applications of head-up displays in commerc	ıal
In-service inspection methods for graphite-		transport aircraft	101.42506
structures on commercial transport aircra [NASA-CR-165746]	ait N82-12142	[AIAA 81-2300] The LANTIEN wide field-of-wiew raster Head-	A82-13506
GROUND BASED CONTROL	802 12142	Display Low Altitude Navigation and	
AN/TPN-25 and AN/GFN-22 precision approach	radars	Targeting IR for Night	
CROTHE TERROR (ARROBETTATOR)	A82-14856		A82-14825
GROUND EPPECT (ABBODYNAMICS) Jet V/STOL wind-tunnel simulation and ground	ndnlano	Head up displays	N82-13052
effects	-492420	HEAT RESISTANT ALLOYS	
	A82-13973	Attack on superalloys by chemical and elect	rolytic
GROUND HANDLING	-4	processes	A82-14365
C-5A unsurfaced tax1 and cff-load demonstra [AIAA PAPER 81-2439]	A 82-13875	'In situ' composites for jet propulsion and	
GROUND SPEED	100	stationary gas turbine applications	
The use of groundspeed, in a wind shear an			A82-15824
flight evaluation of a radar-altimeter-be system for the measurement of groundspeed		HEAVY LIFT HELICOPTERS Heavy lift helicopters - A national technol	OGV
[AD-A104758]	น พ82-12060	opportunity	091
GROUND TESTS			A82-13241
Overview of flight and ground testing with		BELICOPTER CONTECL	
emphasis on the wind tunnel [AIAA PAPEE 81-2474]	A 82-13928	The design of exact nonlinear model followe with application to trajectory autopilot	
Comparison of low-speed handling qualities		helicopter	
ground-based and in-flight simulator tes	ts		A82-13125
[AIAA PAPEE 81-2478]	A82-13936	Helicopter IFB - Fast, present and future a	A82-13245
GUIDANCE (MOTION) Experience with flight test trajectory guid	dance	Navigation for helicopters by multiple use	
	A82-14379	inertial sensors	
GUIDANCE SENSORS	_		A82-14713
Redundancy management of skewed and disper- 'inertial sensors	sed	Application of multiple model estimation techniques to a recursive terrain height	
[AIAA 81-2296]	A82-13503	correlation system	
Development and laboratory test of an inte		_	A82-14768
sensory system /ISS/ for advanced aircra		Experimental evaluation of a perspective tu	nnel
[AIAA 81-2297] Navigation for helicopters by multiple use	A82-13504	display for three-dimensional helicopter approaches	
inertial sensors	01		A82-15847
	A82-14713	HELICOPTER DESIGN	
GUIDE VARES Effect of a part span variable inlet guide	7070 OT	The Agusta A129	A82-13237
TP34 fan performance	vane on	Public service helicopters - Is the grass of	
[NASA-CR-165458]	N82-12075	on the other side of the fence	
Transonic flows in an air inlet with large		P-4/	A82-13238
incidence and the effect of a blowing tr	ар N82+13071	Fatigue methodology - A technical management system for helicopter safety and durabili	
GUBS (ORDNABCE)	802-13071	Sistem for Refresheer Surery and detablish	A82-13240
Evaluation of advanced all-to-air gunnery	fire	Heavy lift helicopters - A national technol	ogy
control systems	102 44350	opportunity	A82-13241
GUST ALLEVIATORS	A82-14750	The FAA's proposed helicopter certification	
Design for active and passive flutter supp	ression	inc in a paloposca norrospect constitution	A82-13242
and gust alleviation		Ware strake protection	
[NASA-CR-3482]	N82-13147	Design of a crashworthy crew seat for the E	A82-13246
ā ē		Vertol Chinook helicopter	Joeing
H		•	A82-14975
HALL EPPECT		How the helicopter cockpit designer uses di	gital
Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field		avionics	N82-13049
[NASA-TH-82750]	N82-13908	Integration of controls and displays in US	
HARMONIC EXCITATION		helicopter cockpits	
Structural dynamics: Modified calculation		DMITCODEDD DECTEDS	N82-13053
natural and harmonically excited vibrati modified structures; increased computati		BRLICOPTER REGINES The protection of gas turbine blades - A pl	latinum
efficiency	·	aluminide diffusion coating	
[BMVG-FBWT-81-1]	N82-13457	·	A82-14364
"Little people" problem /MA-2 torso harnes	e/	BBLICOPTEE PERPORMANCE The Agusta A129	
Profes Scotte Stonten \nu_5 corpo ngrnes	A82-14958		A82-13237

Heavy lift helicopters - A national technology	og y	HOT SURFACES
opportunity	A82-13241	Development and testing of dry chemicals in advanced extinguishing systems for jet engine
Helicopter icing		nacelle fires
Planning a helicopter flight test program	A82-13243	[NASA-CR-165011] N82-13186
	A82-13881	Application of the ONERA dynamic stall model to a
Plight wibration oftimization wia conformal		helicopter blade in forward flight
Progress report - CH-47 modernization progra		[ONERA, TP NO. 1981-89] A82-13992 Hover tests of the XV-15 Tilt Rotor Research
Safety of helicopters in flight Russian		Alrcraft [AIAA FAPEE 81-2501] A82-14386
System identification helicopter parameters.	182-14946 •	Experimental and analytical studies of a model helicopter rotor in hover
Determination from flight tests, phase 2	107_17177	[NASA-TM-81232] N92-12042
[BMVG-PBWT-80-12] HELICOPTER PROPELLER CRIVE	182-13137	HUGHES AIRCRAFT Pave Mover Flight Test Program
In-flight computation of helicopter transmis	sion	[AIAA PAPEE 81-2492] A82-14380
fatigue life expenditure	•	HUMAN PACTORS ENGINEERING
[AIAA PAPEE 81-2434]	82-13872	Digital avionics - What a pilot expects to see
#BLICOPTER TAIL ROTORS An analysis of civil aviation propeller-to-p	orcon	[AIAA 81-2217] A82-13455
accidents: 1965-1979	erzon	Electronic flight deck displays for transport aircraft
	N82-12053	[AIAA 81-2264] A82-13483
HELICOPTER WAKES		F/A-18 'Hornet' - One man operability
Experimental and analytical studies of a mod	lel	[AIAA 81-2266] A82-13484
helicopter rotor in hover [NASA-TM-81232]	182-12042	'Little people' problem /MA-2 torso harness/
BELICOPTERS	102-12042	A82-14958 Computer image generation for flight simulation
Instrumentation to determine the suitability	of	A82-15599
RNAV systems for helicopter navigation in	the	Computer Air Carrier Symposium
national airspace system /NAS/		[AD-A104894] N82-12054
[AIAA PAPER 81-2514] Flight testing the suspended maneuvering sys	182-13911	Color CRT displays for the cockpit
helicopter firefighting and rescue tec	hniques	N82-13051 Using voice control onboard combat aircraft
[AIAA PAPER 81-2498] HASEP - Survival from crashed Navy belicopte	182-13922 Prs	N82-13056 Experimental investigation of a helmet mounted
	182-14977	sight/display for helicopter
Investigation of the structural degradation personnel hazards resulting from helicopte		N82-13060
composite structures exposed to fires and		Tanker avionics and aircrew complement evaluation N82-13063
explosions	J L	F/A 18 Hornet crew station
	82-12057	N82-13064
Flight evaluation of LORAN-C as a helicopter		Baven aircraft filter-absorber agrıcultural
navigation aid in the Baltimore Canyon oil	Ļ	aircraft
exploration area [AD-A105260]	182-12059	[AD-A098962] N82-13139 BYDRAULIC CCNTRCL
Electronic Master Monitor and Advisory Displ		Will power-by-wire replace power-by-hydraulics
System (EMMADS)	•	A82-14707
	182-12067	HYDRAULIC PLUIDS
A vapour cycle cabin cocling system for the King MK.50 belicopter	Sea	Efficient use of working fluids in aviation
	182-12069	hydraulic systems A82-15724
Experimental investigation of a helmet mount		HYDROCAEBON FUEL PRODUCTION
sight/display for helicopter		Development of catalytic systems for the
	182-13060	conversion of syngas to jet fuel and diesel fuel
Helicopter reliability and maintainatility t during development and production	renas	and higher alcohols
rad-a1057751	182-13136	[DE82-000067] N82-12255 HYDROCARBON FUELS
HELHET HOUNTED DISPLAYS		Development and testing of dry chemicals in
Head up displays		advanced extinguishing systems for jet engine
Experimental investigation of a helmet mount	182-13052	nacelle fires
sight/display for helicopter	ea	[NASA-CR-165011] N82-13186
	182-13060	
Use of a helmet-mounted matrix display for		İ
presenting energy-maneuverability informat	ion	ICE PORBATICE
during simulated close combat	100 42064	Helicopter icing
HIGH PRESSURE	182-13061	IDENTIFYING A82-13243
The operational characteristics of turbojets	S.	An update of an integrated CNI system - TIES
giving particular attention to the cooled	•	Communication, Navigation, and Identification
high-pressure turbine		provided by Tactical Information Exchange System
HIGH VOLTAGES	182-14414	[AIAA 81-2292] A82-13500
Computer modeling of an aircraft HVDC electr	rical	IMAGE PROCESSING Computational considerations for fusion in target
system	1041	identification systems multisensor correlation
	182-14819	A82-14735
High voltage/high power for airborne applica		Algorithms for an adaptive dynamic window in
HOMING DEVICES	182-15918	electronic map systems
A VHF homing system with VHF radiotelephony	for	A82-14769 Inverse SAR and its application to aircraft
area-representative strip-survey flights	=	classification
conducted, as part of combined forest		A82-14871
inventories, with light aircraft carrying and 35 mm cameras	/O mm	INAGING TECHNIQUES
	182-15748	Weather impact on low-altitude imaging infrared sensors in Europe - An availability model
•		A82-14779

SUBJECT INDEX INSTALLATION MANUALS

Head up displays		Implementing the DAIS executive Digita	1
IMPACT DAMAGE	N82-13052	Avionics Information System software feat for aircraft systems	
Wire strike protection	100 10046	INFRARED DETECTORS	A82-14814
IMPACT RESISTANCE The load-carrying behavior of a trapezoida	A82-13246	Collection and simulation of spatial infra signatures of military jet aircraft	red
aluminum-alloy supporting element, subje a compressive stress, in the postbucklin	ected to	[AIAA PAPER 81-2494] INFRARED IMAGERY	A82-13921
IMPACT TESTS	A82-14418	Weather impact on low-altitude imaging inf. sensors in Europe - An availability mode.	
Test and evaluation of improved aircrew re	estraint		A82-14779
systems IN-PLIGHT MONITORING	A82-14974	The LABTIBN wide field-of-view raster Head Dısplay Low Altıtude Navigation and Tarqeting IB for Night	-0p
Computer-in-control selection logic for a	triplex	largeting in for hight	A82-14825
digital flight control system [AIAA 81-2236]	A82-13465	INITIATORS (EXPLOSIVES) A ballistic design model for initiators fo	r
In-flight computation of helicopter transm	aission	aircraft personnel escape systems	
fatigue life expenditure [AIAA PAPER 81-2434]	A82-13872	Analytical and experimental characterizati	A82-14984 on of
Direct strike lightning measurement system aircraft		the JAU-14/A cartridge actuated initiato use in aircrew escape system performance	r for
[AIAA PAPER 81-2513] Improved techniques for the calibration ar	A82-13910	evaluation	A82-14985
measurement of in-flight loads	ıd	INLET AIRPRANE CONFIGURATIONS	MO2-14303
[AIAA PAPES 81~2502]	A82-13924	Aerodynamics of Power Plant Installation	N82-13065
Plight trail of the Aircraft Fatigue Data System (AFDAS) Mk 2 prototype	Analysis	[AGARD-CP-301] Performance of highly integrated inlets fo	
[AD-A105270]	N82-12066	superscnic aircraft	
Electronic Master Monitor and Advisory Dis System (EMMADS)	splay	Some RAE research on shielded and unshield	N82-13066 ed
[AD-A105082] INCIDENCE	N82-12067	fuselage mounted air intakes at subsonic	
Transonic flows in an air inlet with large	e	supersonic speeds	N82-13068
incidence and the effect of a blowing tr		Prediction and measurement of time-variant three-dimensional flows in military airc	
The numerical solution of incompressible t	turbulent	intakes	N82-13069
flow over airfoils	N82-12030	Effects of intake geometry on circular pit intake performance at zero and low forwa	rd speeds
INDEXES (DOCUMENTATION) Index of National Aviation Facilities Experience technical reports 1972 - 1977	erimental	The design and development of the Tornado air intake	N82-13070 engine
[AD-A104759]	N82-12056		N82-13074
INERTIAL HAVIGATION Fault detection for two physically separat	had	Final report on the FueFo-4 major theme: Interference drag with airframe/engine	
communicating inertial measurement units	ŝ	integration on fighter aircraft	N82-13116
The use of separated multifunction inertia	A82-13142 al	[BMVG-PEWT-79-20] INLET PLON	
sensors for flight control [AIAA 81-2295]	A82-13502	A large-scale investigation of engine infl inlet performance at angle-of-attack	uence on
Navigation for helicopters by multiple use inertial sensors	e of	[AIAA PAPER 81-2481] Effect of a part span variable inlet guide	A82-13939 Vane on
Prolection convers of source to Tip (gring	A82-14713	TP34 fan performance	NO3 . 1207E
Evaluating scurces of error in BAR/GIANS navigation using a Kalman postprocessor		[NASA-CR-165458] Prediction and measurement of time-variant	N82-12075
Electronically Ágile Radar/Gımtaled Elec suspended gyro Airborne Navigation Syste	ctrically em	three-dimensional flows in military airc intakes	
INERTIAL PLATFORMS	A82-14739	Effects of intake geometry on circular pit	N82-13069 ot
A failure detection and isclation system in tactical aircraft with separated IMUs		intake performance at zero and low forwa	rd speeds N82-13070
INERTIAL BEFERENCE SYSTEMS	A82-14684	Subsonic military aircraft engine intake: integrated theoretical experiment design	
The use of separated multifunction inertia	al		N82-13073
sensors for flight control [AIAA 81-2295]	A82-13502	The design and development of the Tornado air intake	
Strapdown inertial reference systems perfo analysis	ormance	An acquisition and analysis system for dyn	N82-13074 amic
THREADTEC	A82-14682	tests of air inlets	
Purther test results of parachutes with au inflation modulation /A.I.M./	utomatic	Model testing techniques for measuring inl	N82-13082 et drag N82-13084
INFORMATION PLON	A82-14965	Thrust modulation methods for a subsonic V aircraft	/STCL
Higher order Information Transfer Systems	are coming	[NASA-TH-82747]	N82-13112
[AIAA 81-2317]	A82-13517	Numerical analysis of the scramjet-inlet f	
INFORMATION SYSTEMS An update of an integrated CHI system - Ti	TES	field by using two-dimensional Navier-St equations	URES
Communication, Navigation, and Identific	cation	[NASA-TP-1940]	N82-13142
provided by Tactical Information Exchange [AIAA 81-2292]	Je System A82-13500	Practical aspects of instrumentation syste	<u>n</u>
Advanced wearon systems - Integration tech		installation, volume 13	
Digital Avionic Information System [AIAA 81-2213]	A82-13533	[NASA-TH-84067]	N82-13140
Information technology and its impact on t			
evaluation at the Naval Air Test Center [AIAA PAPER 81-2396]	A82-13894		
,			

INSTALLING			
Wind tunnel test and analysis techniques us	sing	J	
powered simulators for civil nacelle installation drag assessment		J-79 ENGINE	
2 2 3	N82-13088	The F-16/79 test program	
INSTRUMENT COMPRESATION		[AIAA FAPEE 81-2414]	A82-13855
AFFTC standard airspeed calibration procedum [AD-A104830]	ures N82-12074	JAMMERS Second - Moch cohoront dammer flight test	
INSTRUMENT BREORS	MOZ- 12014	Georgia Tech coherent jammer flight test [AIAA FAPER 81-2452]	A82-13898
A concept for a high-accuracy, low-cost		JET AIRCRAFT	
accelerometer	100 4460r	Collection and simulation of spatial infrar	red
INSTRUMENT FLIGHT RULES	A82-14685	signatures of military jet aircraft [AIAA PAPER 81-2494]	A82-13921
Helicopter icing		Operational evaluation of the new generation	
United TER Post second and follows	A82-13243	jet transport aircraft	
Helicopter IFR - Past, present and future a	A82-13245	[AIAA PAPER 81-2377] Jet V/STOL wind-tunnel simulation and groun	A82-13942
INSTRUMENT PACKAGES	10245	effects	udiane
Planning a helicopter flight test program			A82-13973
[AIAA PAPER 81-2381] INTERACTIVE CONTEGL	A82-13881	Plight management systems for modern jet ai	
Advanced display systems for crew stations	of	The influence of wind shear and wertical wi	A82-14778
tactical aircraft		takeoffs and go-arounds	
[AIAA 81-2312]	A82-13514		A82-15823
The development and use of a computer-interdata acquisition and display system in a		The influence of closed-coupled, rear fusel mounted macelles on the design of an adva	
environment	,	high speed wing	anceu
[AIAA PAPEE 81-2371]	A82-13946		N82-13092
A synthesis technique for highly uncertain interacting multivariable flight control		JET ENGINE FUELS Determination and analysis of jet and missi	ile fuel
interacting multivariable linguit control	A82-14827	deposits	rie inei
INTERCEPTION		[AD-A105458]	N82-12248
Comparison between the exact and an approximate feedback solution for medium range interc		Development of catalytic systems for the	1 61
problems	eption	conversion of syngas to jet fuel and dies and higher alcohols	sel Inel
F	A82-13106	[DE82-000067]	N82-12255
INTERPACES	_	JET ENGINES	
Practical aspects of instrumentation system installation, volume 13		Failure analysis of variable reluctance stemetric fuel control syst	
[NASA-TM-84067]	N82-13140	jet engine	
INTERPERENCE DRAG		47 1-1	A82-14792
Evaluation of an experimental technique to investigate the effects of the engine pos	sition	'In situ' composites for jet propulsion and stationary gas turbine applications	1
on engine/pylon/wing interference		pedetoball den gerning abbitogram	A82-15824
Mt fluores of elegad-gourled mean fugal	N82-13090	Subsonic mulitary aircraft engine intake:	An
The influence of closed-courled, rear fusel nounted nacelles on the design of an adva		integrated theoretical experiment design	N82-13073
high speed wing		The design and development of the Tornado e	
lunguagia secondo of a bigh burgas autic	N82-13092	air intake	
Aerodynamic aspects of a high bypass ratio installation on a fuselage afterbody	endine	Integration of advanced exhaust nozzles	N82-13074
	N82-13093		N82-13075
Final report on the PueFo-4 major theme: Interference drag with airframe/engine		Development and testing of dry chemicals in advanced extinguishing systems for jet er	
integration on fighter aircraft		nacelle fires	путпе
[BHVG-PBWT-79-20]	N82-13116	[NASA-CB-165011]	N82-13186
INTERPREBECE LIFT Evaluation of an experimental technique to		JET EXHAUST Prediction of subsonic aircraft flows with	ict
investigate the effects of the engine pos	sition	exhaust interactions	Jec
on engine/pylon/wing interference			N82-13096
INVESTMENTS	N82-13090	JET MIXING FLOW Investigation of acoustic interactions in	int
The payoff from U.S. investment in aeronaud	tical	thrust augmenting ejectors	,
research and development	300 40705	[AD-A106083]	N82-13835
A new approach to modeling the cost of owner	A82-14793	JET THRUST Performance assessment of an advanced rehea	a+ed
for aircraft systems		turbo fan engine	aceu
[AD-A104434]	N82-13979	[AIAA PAPER 81-2447]	A82-13879
INVISCID FLOW Aerodynamic aspects of a high bypass ratio	engine		
installation on a fuselage afterbody		K	
1 and mathed for atuaning	N82-13093	KALMAN PILTERS	
A numerical method for studying nacelle-jet-airfoil interaction in inviso	c1d	Evaluating sources of error in EAR/GEANS navigation using a Kalman postprocessor	
three-dimensional flow		Electronically Agile Radar/Gimbaled Elect	trically
ISOPARAMETRIC PINITE BLEMBUTS	N 82-13094	suspended gyro Airborne Wavigation System	
A set of finite elements developed for the	dynamic	Application of multiple model estimation	A82-14739
computation of composite helicopter blade	es	techniques to a recursive terrain height	
[ONERA, TP NO. 1981-67] ITERATIVE SOLUTION	A82-13990	correlation system	A82-14768
Computational methods of robust controller	design		MOZ-14/08
for aerodynamic flutter suppression	-	1	
[NASA-CR-164983]	N82-12080	L-1011 AIRCHAPT	
		Fault isolation methodology for the L-1011	digital
		avionic flight control system	
		[AIAA 81-2223]	A82-13458

SUBJECT INDEX LONGITUDINAL STABILITY

LAGRANGE MULTIPLIERS		LIGHT AIRCRAFT	
Hathematical programming in engineering de- problems	sign	Wing design for light transport aircraft wi improved fuel economy	tb
Produces	A82-15864		A82-14416
LANDING AIDS	_	LIGHTBIBG	
Digital signal processing on a background or rereflections for the international airc		Thunderstorm hazards flight research - Progoverview	
landing system	A82-13703	[AIAA PAPER 81-2412] Direct strike lightning measurement system	A82-13853
LANDING SIMULATION	202 10:10	aircraft	201
Computer-animated predictive displays for		[AIAA PAPER 81-2513]	A82-13910
microwave landing approaches	A82-15816	A recursive time domain analysis of distril	
LASER APPLICATIONS	A02-13010	line grid networks with application to the LTA/EMF problem Lightning Threat Anal	
Digital detection and processing of laser	реасор		A82-14761
signals for aircraft collision hazard wa	rning	Investigation of severe lightning struke in	ncidents
[AIAA 81-2328]	A82-13525	to two USAF F-106A aircraft	uca_12052
LASER RANGER/TRACKER ATARK laser tracking system		[NASA-CR-165794] LIGHTNING SUPPRESSION	N82-12052
	A82-13016	Assessment methodology of the lightning thr	eat to
Options for GTF precision automated tracki	ng system	advanced aircraft	
airborne laser tracking system	A82-13020		A82-14759
LASER TARGET DESIGNATORS	A02-13020	LINE OF SIGHT Experimental investigation of a helmet mour	nt ed
Electro-optical vector scoring system	for	sight/display for helicopter	
missile miss distance in fleet training			N82-13060
	A82-13945	LIBBAR PROGRAMMING	
LASER TARGETS ATARK laser tracking system		Mathematical programming in engineering des problems	sign
Allah laser tracking system	A82-13016	broniems	A82-15864
LATERAL CONTROL		LINEAR SYSTEMS	
Design and flight test of a lateral-direct	ional	Computational methods of robust controller	design
command augmentation system [AIAA 81-2331]	A82-13527	for aerodynamic flutter suppression [NASA-CR-164983]	N82-12080
A cost effective method for the control of		LINEARITY	102 12000
due to side slip on a low speed aircraft		Effect of vacuum exhaust pressure on the	
[AIAA PAPEE 81-2422]	A82-13861	performance of MHD ducts at high D-field	43000
Analysis of a longitudinal pilot-induced oscillation experienced on the approach	and	[NASA-TM-82750] LIQUID CRYSTALS	N82-13908
landing test of the space shuttle	ana ana	An integrated control panel utilizing a	
[NASA-TM-81366]	N82-13149	programmable varistor-multiplexed dichro	ıc
LATERAL STABILITY		liguid crystal display	
A cost effective method for the control of due to side slip on a lcw speed aircraft		[AIAA 81-2303] LIQUID ROCKET PEOPELLANTS	A82-13508
	A82-13861	Determination and analysis of jet and missi	ıle fuel
LEADING EDGES	4	deposits	
AV-8B technical update - leading edge root		[AD-A105458]	N82-12248
extension develorment	A82-14940	LOAD DISTRIBUTION (FORCES) Calculation of wing-body-nacelle interferen	nce in
LEAR JET AIRCRAFT	A02 14340	subsonic and transonic potential flow	uce in
Determining hinge moments and empennage ai	rload	•	N82-13095
parameters from flight data for Learjet		Prediction of subsonic alreraft flows with	jet
· The all composite lear Fan 2100	A82-13120	exhaust interactions	N82-13096
The dir composite real ran 1.00	A82-14936	LOAD TESTS	13030
Acceptance testing of the Calspan variable		The load-carrying behavior of a trapezoidal	
stability Learjet	100 44027	aluminum-alloy supporting element, subject	
LEAST SQUARES METBOD	A82-14937	a compressive stress, in the postbuckling	g region A82-14418
Performance estimation from non-steady man	oeuvres	Vibration test procedures for accessory and	
	A82-13863	drive gearboxes on Atar 09C engines	
LIPE CYCLE COSTS		engines	NOO 12076
Advanced integrated CNI architectures Communications, Navigation and Identific	ation	[AD-A105269] LOGIC CIRCUITS	N82-12076
avionics for tactical aircraft and attac		Automatic digital gain ranging for flig	ght test
helicopter		telemetry data	-
2.15-2.45-2-45-2-46-2-4	A82-14763	[AIAA PAPER 81-2370]	A82-13947
A new approach to modeling the cost of own for aircraft systems	ersnip	LOGIC DESIGN Computer-in-control selection logic for a	triplex
[AD-A104434]	N82-13979	digital flight control system	cripica
LIPE SUPPORT SYSTEMS		[AIAA 81-2236]	A82-13465
U.S. Navy life support development trends	193-14053	LOGISTICS	+
LIPT	A82-14952	The all electric airplane - Its development logistic support	c and
A technique to determine lift and drag pol	ars in	Together Defeat	A 82-14709
flight and their application		LONGITUDIBAL CONTROL	
[AIAA PAPER 81-2420]	A82-13859	A decoupled control system for improved fla	ight
Progress report - CH-47 modernization prog	rag	performance in wind shear	A82-13079
	A82-14930	Enhanced aircraft handling qualities by	
LIFT DRAG RATIO		longutudinal dynamics mode decoupling	
Development of a lifting parachute to prov		IORGIGUDI DAI COADTITOV	A82-14826
self-dispersing capability for an Avco-d tactical munition	esigned	LONGITUDIENT STABILITY Analysis of a longitudinal pilot-induced	
[AIAA PAPER 81-1928]	A82-13962	oscillation experienced on the approach	and
LIGHT AIRBORNE MULTIPURPOSE SYSTEM		landing test of the space shuttle	
Light Airborne Multi-Purpcse System	162_12200	[NASA-TH-81366]	N82-13149
	∆ 82-13244		

LORAN C A Loran-C prototype navigation receiver for		The Maneuvering Flight Path Display - A fl: trajectory solution display concept	ight
general aviation	00 43530	-	A82-14824
Flight evaluation of LCRAb-C as a helicopter		Using voice control onboard combat aircraft	N82-13056
navigation aid in the Baltimore Canyon oil exploration area	. #	ANAGEMENT INFORMATION SYSTEMS Conceptual design of an integrated power as	nd
[AD-A105260] Design study report for General Aviation Lor	182-12059 :an-C	avionics information system	A82-14788
receiver	H	ANAGEMENT METHODS	
[AD-A104921] LOW ALTITUDE	182-12062	A summary of the Naval Postgraduate School Research Program	
Application of multiple model estimation techniques to a recursive terrain beight	A	[AD-A104112] AMAGEMENT SYSTEMS	N82-13975
correlation system	82-14768	Puel efficient flight profiles in an ATC fl management environment	low
The LANTIBN wide field-cf-view raster Head-U	p	•	A82-13078
Display Low Altitude Navigation and Targeting IR for Night	B	AMECUREABILITY C-5A unsurfaced taxi and off-load demonstra	ations
LOW COST	82-14825	(AIAA FAPER 81-2439) Use of a helmet-mounted matrix display for	A82-13875
Low cost programmable multisimulator facilit		presenting energy-maneuverability informa	ation
A concept for a high-accuracy, low-cost	82-13534	during simulated close combat	N82-13061
accelerometer	82-14685	Maneuver load control for the reduction of loads and improvement of the maneuverabil	
LOW SPEED A cost effective method for the control of r	·n11	modern fighter aircraft [BMVG-FBWT-81-2]	N82-13138
due to side slip on a lcw speed aircraft	Ħ	AP MATCHING GUIDANCE	
Effects of intake geometry on circular pitot		Airborne Electronic Map Systems. I - Design	a 182-14770
intake performance at zero and lcw forward	speeds 82-13070	APPING Alleronic Map Systems. I - Design	a
LOW SPRED WIND TORNELS A large-scale investigation of engine influe	ence on	Airborne Electronic Terrain Map System. II	A82-14770
inlet performance at angle-of-attack		Applications	
LUBRICATING OILS	.82-13939 B	APS	A82-14773
Optimization of requirements on the pitting-prevention properties of turbojet-	engine	The electronic terrain map - A new avionics integrator	S
oils	-	[AIAA 81-2289] ARKET RESEARCH	A82-13498
_	.02 13723	Public service helicopters - Is the grass of	greener
N.A		on the other side of the fence	
M			A82-13238
MACH NUMBER	8	ATHEBATICAL MODELS	
_ 			
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CHERA's F1 and S1M tunnels		ATHEMATICAL MODELS Digital control for flexible aircraft using	g A82-13094
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CHERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airflo	A wind 82-13091 : Mach	ATHENATICAL MODELS Digital control for flexible aircraft using reduced order models	g A82-13094 A82-13314
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and S1M tunnels Nirframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airflueffects	A wind 82-13091 : Mach	ATHERATICAL MODELS Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation	9 A82-13094 A82-13314 A82-13968 n and
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CHERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloeffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the	M wind 182-13091 : Mach	ATHERATICAL MODELS Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft	A82-13094 A82-13314 A82-13968 n and ter
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloeffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field	M wind 182-13091 : Mach : B 82-13098	ATHERATICAL MODELS Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopy composite structures exposed to fires and explosions	A82-13094 A82-13314 A82-13968 n and ter d/or
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloeffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750]	Mayind 182-13091 Mach 182-13098 182-13908	ATHEMATICAL MODELS Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopy composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual	A82-13094 A82-13314 A82-13968 n and ter d/or N82-12057
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloeffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synchronic premanent Magnet Generator for Variable	A wind 182-13091 : Mach 182-13098 182-13908 (stem	ATHERATICAL MODELS Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopic composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual approach and landing [NIR-MP-80019-U]	A82-13094 A82-13314 A82-13968 h and ter d/or N82-12057
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloeffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP system of the performance of MED ducts at high D-field [NASA-TM-82750] NAGNETS High speed PMG containment study for VSCP system of the performance of MED ducts at high D-field [NASA-TM-82750]	A wind 182-13091 : Mach 182-13098 182-13908 (stem	ATHEMATICAL MODELS Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopic composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual approach and landing	A82-13094 A82-13314 A82-13968 n and ter d/or N82-12057
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloreffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synchronic systems are performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synchronic systems are performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synchronic systems are performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synchronic systems are performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synchronic systems are performed by the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synchronic systems are performed by the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synchronic systems are performed by the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synchronic systems are performed by the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synchronic systems are performed by the performance of MED ducts at high D-field [NASA-TM-82750] Magnet Studies of MED ducts at high D-field [NASA-TM-82750] Magnet Studies of MED ducts at high D-field [NASA-TM-82750] Magnet Studies of MED ducts at high D-field [NASA-TM-82750] Magnet Studies of MED ducts at high D-field [NASA-TM-82750] Magnet Studies of MED ducts at high D-field [NASA-TM-82750] Magnet Studies of MED ducts at high D-field [NASA-TM-82750] Magnet Studies of MED ducts at high D-field [Mayind 182-13091 Mach 182-13098 182-13908 Testem 182-14791	ATHERATICAL MODELS Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopy composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual approach and landing [NIR-MP-80019-U] Subsonic military aircraft engine intake:	A82-13094 A82-13314 A82-13968 n and ter d/or N82-12057 N82-12064 An N82-13073
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloreffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synchronic and predictions MAINTAINABILITY Helicopter reliability and maintainability to during development and production	Mayind 182-13091 Mach 182-13098 182-13908 Testem 182-14791	ATHEMATICAL MODELS Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopy composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual approach and landing [NiR-MP-80019-U] Subsonic military aircraft engine intake: integrated theoretical experiment design A real time Pegasus propulsion system model VSIOL piloted simulation evaluation	A82-13094 A82-13314 A82-13968 n and ter d/or N82-12057 N82-12064 An N82-13073
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CHERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloweffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synon- Permanent Magnet Generator for variable Speed Constant Prequency applications MAINTAINABILITY Helicopter reliability and maintainability to during development and production [AD-A105775]	## Wind ## ## ## ## ## ## ## ## ## ## ## ## ##	Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopic composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual approach and landing [NIR-MP-80019-U] Subsonic military aircraft engine intake: integrated theoretical experiment design A real time Pegasus propulsion system model vs101 piloted simulation evaluation [NASA-TM-82770] A new approach to modeling the cost of owner	A82-13094 A82-13314 A82-13968 h and ter d/or N82-12057 N82-12064 An N82-13073 for N82-13144
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloreffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP syn Fermanent Magnet Generator for variable Speed Constant Prequency applications MAINTAINABILITY Helicopter reliability and maintainability to during development and production [AD-A105775] MAINTENANCE Practical aspects of instrumentation system installation, volume 13	Mach 182-13098 182-13098 182-13908 182-14791 182-14791 182-14791	Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopic composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual approach and landing [NiR-MP-80019-U] Subsonic military aircraft engine intake: integrated theoretical experiment design A real time Pegasus propulsion system model vs101 piloted simulation evaluation [NASA-TM-82770] A new approach to modeling the cost of own for aircraft systems [AD-A104434]	A82-13094 A82-13314 A82-13968 h and ter d/or N82-12057 N82-12064 An N82-13073 for N82-13144
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CHERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloweffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synchronic system and study for variable speed Constant Prequency applications MAINTAINABILITY Helicopter reliability and maintainability the during development and production [AD-A105775] MAINTENANCE Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] MAN BACHIER SYSTEMS	Mach 182-13098 182-13098 182-13908 182-14791 182-14791 182-14791	ATHENATICAL MODELS Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopic composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual approach and landing [NIR-MP-80019-U] Subsonic military aircraft engine intake: integrated theoretical experiment design A real time Pegasus propulsion system model VSTOL piloted simulation evaluation [NASA-TB-8270] A new approach to modeling the cost of owner for aircraft systems	A82-13094 A82-13314 A82-13968 and ter d/or N82-12057 N82-12064 An N82-13073 I for N82-13144 ership N82-13979
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloreffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synchronic for Variable Speed Constant Prequency applications MAINTAINABILITY Helicopter reliability and maintainability to during development and production [AD-A105775] MAINTENANCE Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] MAN MACHINE SYSIEMS Avionics implications from Weapon system	## Wind ## ## ## ## ## ## ## ## ## ## ## ## ##	Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopic composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual approach and landing [NIR-MP-80019-U] Subsonic military aircraft engine intake: integrated theoretical experiment design A real time Pegasus propulsion system model vs101 piloted simulation evaluation [NASA-TH-82770] A new approach to modeling the cost of owner for aircraft systems [AD-A104434]	A82-13094 A82-13314 A82-13968 and ter d/or N82-12057 N82-12064 An N82-13073 I for N82-13144 ership N82-13979
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CHERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloweffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synchematics High speed PMG containment study for VSCP synchematics MAINTAINABILITY Helicopter reliability and maintainability the during development and production [AD-A105775] MAINTENANCE Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] MAN MACHIBE SYSIEMS Avionics implications from Weapon system operational utility studies on Manned Air Simulators	Mach 182-13098 182-13098 182-13908 182-13908 182-14791 1rends 182-13136 182-13140	Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopic composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual approach and landing [NIR-MP-80019-U] Subsonic military aircraft engine intake: integrated theoretical experiment design A real time Pegasus propulsion system model vS101 piloted simulation evaluation [NASA-TM-82770] A new approach to modeling the cost of owner for aircraft systems [AD-A104434] ATHERMATICAL PROGRAMMING Mathematical programming in engineering desproblems	A82-13094 A82-13314 A82-13968 h and ter d/or N82-12057 N82-12064 An N82-13073 I for N82-13144 ership N82-13979 sign A82-15864
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airflo effects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP sy Fermanent Magnet Generator for variabl Speed Constant Prequency applications MAINTAINABILITY Helicopter reliability and maintainability the during development and production [AD-A105775] MAINTENANCE Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] MAN MACHINE SYSTEMS Avionics implications from Weapon system operational utility studies on Manned Air Simulators [AIAA 81-2230] Have we overlocked the Filot's role in an	Mach 182-13098 182-13098 182-13908 182-13908 182-13136 182-13140	Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopy composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual approach and landing [NIR-MP-80019-U] Subsonic military aircraft engine intake: integrated theoretical experiment design A real time Pegasus propulsion system model vsiol piloted simulation evaluation [NASA-TM-82770] A new approach to modeling the cost of own for aircraft systems [AD-A104434] ATHERATICAL PROGRAMMING Mathematical programming in engineering desproblems [AXIMUM LIKELIHOCD ESTIMATES] Cn matching the systems identification tect to the particular application in evaluation in evalu	A82-13094 A82-13314 A82-13968 n and ter d/or N82-12057 N82-12064 An N82-13073 1 for N82-13144 ership N82-13979 sign A82-15864 hnique
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CHERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloweffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synchem system of the containing development and production [AD-A105775] MAINTAINABILITY Helicopter reliability and maintainability the during development and production [AD-A105775] MAINTENANCE Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] [NASA-TM-84067] MAN MACHINE SYSTEMS Avionics implications from weapon system operational utility studies on Manned Air Simulators [AIAA 81-2230] Have we overlocked the rilot's role in an automated flight deck [AIAA 81-2262]	A wind 182-13091 182-13098 182-13908 182-13908 182-14791 181-13136 182-13136 Combat 182-13463	Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopic composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual approach and landing [NIR-MP-80019-U] Subsonic military aircraft engine intake: integrated theoretical experiment design A real time Pegasus propulsion system model VSTOL piloted simulation evaluation [NASA-TH-82770] A new approach to modeling the cost of own for aircraft systems [AD-A104434] ATHEBATICAL PROGRAMMING Mathematical programming in engineering desproblems MAXIMUM LIKELIHOCD ESTIMATES Con matching the systems identification technical contents of the systems identificati	A82-13094 A82-13314 A82-13968 n and ter d/or N82-12057 N82-12064 An N82-13073 1 for N82-13144 ership N82-13979 sign A82-15864 hnique
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airflo effects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP sy Fermanent Magnet Generator for Variabl Speed Constant Prequency applications MAINTAINABILITY Helicopter reliability and maintainability the during development and production [AD-A105775] MAINTENAMOR Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] MAN MACHIBE SYSTEMS Avionics implications from weapon system operational utility studies on Manned Air Simulators [AIAA 81-2230] Have we overlocked the pilot's role in an automated flight deck	A wind 182-13091 182-13098 182-13908 182-13908 182-14791 181-13136 182-13136 Combat 182-13463	Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopic composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual approach and landing [NIR-MP-80019-U] Subsonic military aircraft engine intake: integrated theoretical experiment design A real time Pegasus propulsion system model VSTOL piloted simulation evaluation [NASA-TH-82770] A new approach to modeling the cost of own for aircraft systems [AD-A104434] ATHEBATICAL PROGRAMMING Mathematical programming in engineering desproblems MAXIMUM LIKELHOCD ESTIMATES Cn matching the systems identification technical test data BEASUBING IESTBURENTS	A82-13094 A82-13314 A82-13968 n and ter d/or N82-12057 N82-12064 An N82-13073 I for N82-13144 ership N82-13979 sign A82-15864 hnique luating A82-13119
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CHERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloreffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP syngles of the containment study for VSCP syngles of the containment for variable speed Constant Prequency applications MAINTAINABILITY Helicopter reliability and maintainability the during development and production [AD-A105775] MAINTENANCE Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] MAN MACHINE SYSTEMS Avionics implications from weapon system operational utility studies on Manned Air Simulators [AIAA 81-2230] Have we overlocked the rilot's role in an automated flight deck [AIAA 81-2262] Avionics systems simulation for the Northrop P/A-18L aircraft [AIAA 81-2274]	A wind 182-13091 182-13098 182-13908 182-13908 182-14791 1rends 182-13136 182-13140 Combat 182-13463	Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopic composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual approach and landing [NIR-MP-80019-U] Subsonic military aircraft engine intake: integrated theoretical experiment design A real time Pegasus propulsion system model vS101 piloted simulation evaluation [NASA-TM-82770] A new approach to modeling the cost of owner for aircraft systems [AD-A104434] ATHERATICAL PROGRAMMING Mathematical programming in engineering desproblems MXIMUM LIKELIHOCD ESTIMATES Cn matching the systems identification technical test data MEASURING IESTRUBENTS Rotor systems research aircraft /RSRA/ roto and moment measurement system	A82-13094 A82-13314 A82-13968 and ter d/or N82-12057 N82-12064 An N82-13073 I for N82-13144 ership N82-13979 sign A82-15864 hnique luating A82-13119 or force
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloreffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synon-permanent Magnet Generator for Variable Speed Constant Prequency applications MAINTAINABILITY Helicopter reliability and maintainability to during development and production [AD-A105775] MAINTENANCE Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] MAN MACHIBE SYSIEMS Avionics implications from Weapon system operational utility studies on Manned Air Simulators [AIAA 81-2230] Have we overlocked the rilot's role in an automated flight deck [AIAA 81-2262] Avionics systems simulation for the Northrop P/A-18L aircraft [AIAA 81-2274] Advanced display systems for crew stations of tactical aircraft	A wind 182-13091 182-13098 182-13908 182-13908 182-14791 1218-13136 182-13140 Combat 182-13463 182-13488 182-13488	Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopy composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual approach and landing [NIR-MP-80019-U] Subsonic military aircraft engine intake: integrated theoretical experiment design A real time Pegasus propulsion system model vsiol piloted simulation evaluation [NASA-TM-82770] A new approach to modeling the cost of own for aircraft systems [AD-A104434] ATHENATICAL PROGRAMMING Mathematical programming in engineering desproblems MAXIMUM LIKELHOCD ESTIMATES Con matching the systems identification technical programming in engineering desproblems MAXIMUM LIKELHOCD ESTIMATES Rotor systems research aircraft /RSRA/ roto and moment measurement system [AIAA PAPER 81-2516] MECHABICAL ENGINEERING	A82-13094 A82-13314 A82-13968 n and ter d/or N82-12057 N82-12064 An N82-13073 l for N82-13144 ership N82-13144 ership A82-13979 sign A82-15864 hnique luating A82-13119 or force A82-13913
MACH NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and S1M tunnels Airframe-propulsion system aerodynamic interference predictions at high transonic numbers including off-design engine airfloreffects MAGNETOHYDRODYNAMICS Effect of vacuum exhaust pressure on the performance of MED ducts at high D-field [NASA-TM-82750] MAGNETS High speed PMG containment study for VSCP synon-permanent Magnet Generator for Variable Speed Constant Prequency applications MAINTAINABILITY Helicopter reliability and maintainability to during development and production [AD-A105775] MAINTENANCE Practical aspects of instrumentation system installation, volume 13 [NASA-TM-84067] MAN MACHIBE SYSIEMS Avionics implications from Weapon system operational utility studies on Manned Air Simulators [AIAA 81-2230] Have we overlocked the rilot's role in an automated flight deck [AIAA 81-2262] Avionics systems simulation for the Northrop P/A-18L aircraft [AIAA 81-2274] Advanced display systems for crew stations of tactical aircraft	A wind 182-13091 182-13098 182-13908 182-13908 182-14791 182-13136 182-13140 Combat 182-13463 182-13488 182-13488	Digital control for flexible aircraft using reduced order models Costs of noise nuisance from aircraft Modeling procedures for handling qualities evaluation of flexible aircraft Investigation of the structural degradation personnel hazards resulting from helicopic composite structures exposed to fires and explosions [AD-A104757] The effect of visual information on manual approach and landing [NIR-MP-80019-U] Subsonic military aircraft engine intake: integrated theoretical experiment design A real time Pegasus propulsion system model vs101 piloted simulation evaluation [NASA-TH-82770] A new approach to modeling the cost of owner for aircraft systems [AD-A104434] ATHERMICAL PROGRAMMING Mathematical programming in engineering desproblems MAXIMUM LIKELIHOCD ESTIMATES Cn matching the systems identification tect to the particular application in evaluation to the particular application in evaluation where the particular application in evaluation moment measurement system [AIAA PAPER 81-2516]	A82-13094 A82-13314 A82-13968 h and ter d/or N82-12057 N82-12064 An N82-13073 l for N82-13144 ership N82-13979 sign A82-15864 hnique luating A82-13119 or force A82-13913 theses, tes for

SUBJECT INDEX MONOPULSE BADAR

NAME OF TAXABLE	
MBTAL COATINGS	LHX - An advanced avionics system design
The protection of gas turkine blades - A platinum	[AIAA 81-2249] A82-13472
aluminide diffusion coating A82-14364	Flat panel developments for future military aircraft [AIAA 81-2302] A82-13507
Progress in protective coatings for aircraft gas	Fiber-optic immunity to PMI/EMP for military
turbines: A Beview of NASA sponsored research [NASA-TM-82740] N82-12216	aircraft [AIAA 81-2339] A82-13529
METAL PINISHING	Recent improvements at the Naval Air Test Center
The use of metal finishing in aircraft fuel systems	for increased test system flexibility
N82-12077 HETAL SHEETS	[AIAA PAPER 81-2392] A82-13888 Collection and simulation of spatial infrared
The technology of sheet-metal stamping in the	signatures of military jet aircraft
production of aircraft /2nd revised and enlarged	[AIAA PAPER 81-2494] A82-13921
edition/ Russian bock 182-14998	KC-10, flight test program management - The
METAL WORKING	contractor's viewpoint [AIAA PAPEE 81-2380] A82-14384
The technology of sheet-metal stamping in the	Puture directions in CNI integrated avionics
production of aircraft /2nd revised and enlarged	Now advances in signal processing technology for
edition/ Russian bock A82-14998	New advances in signal processing technology for integrated CNI avionics Communication,
HETEOROLOGICAL BADAR	Navigation, and Identification
Commercial airborne weather radar technology A02-14868	A82-14762
METEOROLOGICAL BESEARCH AIRCRAFT	Applications of covariance analysis simulation to avionics flight testing
Thunderstorm hazards flight research - Program	A82-14767
OVERVIEW	Microprocessor flight control application study
[AIAA PAPEE 81-2412] A82-13853 METROROLOGICAL SERVICES	A82-14796 Testing of the SJU-5A ejection seat for the F/A-18
Columbus, Ohio, Voice response system	/HCRNET/ alrcraft
demonstration and evaluation [AD-A104750] N82-12304	A82-14955
[AD-A104750] 882-12304 HETEOROLOGY	Crashworthy military passenger seat development A82-14976
A summary of the Naval Postgraduate School	Electronic flight deck displays for military
Research Program [AD-A104112] N82-13975	transport aircraft N82-13050
METHOD OF CHARACTERISTICS	MILITARY HELICOPTERS
Three dimensional flow investigation with a method	Light Airborne Multi-Purpose System
of characteristics in the inlet region and the blade-to-blade channels of supersonic axial	A82-13244
compressors	Advancing blade concept /ABC/ development test program
[ESA-TT-637] N82-12078	[AIAA PAPER 81-2437] A82-13873
MICROCOMPUTERS	Test and evaluation of improved aircrew restraint
Lockheed Airborne Data System - Distributed microcomputers provide cn-board real-time analysis	systems A82-14974
[AIAA PAPER 81-2367] A82-13949	Integration of controls and displays in US Army
MICROPROCESSORS Digital avionics display processor	helicopter cockpits N82-13053
[AIAA 81-2311] A82-13513	MILITARY TECHNOLOGY
An operational model of specific range for	The interface of multifunction controls and
microprocessor applications in piston-prop	displays to tomorrow's avionics
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] A82-13526 Flight testing De Havilland Aircraft Limited	displays to tomorrow's awionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] A82-13526 Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by	displays to tomorrow's awionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 HIBICOMPUTERS
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] A82-13526 Flight testing De Havilland Aircraft Limited	displays to tomorrow's awionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] A82-13526 Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] A82-13907 Application of a microprocessor controlled cockpit	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE
microprocessor applications in piston-prop general avaation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] A82-13526 Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] A82-13907 Application of a microprocessor controlled cockpit	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE
microprocessor applications in piston-prop general avaation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse	displays to tomorrow's avionics [AIAA 81-220] A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 MISSILE CONTEOL
microprocessor applications in piston-prop general avaation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for ATCEBS monopulse data processing	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 BISSILE CONTROL Electro-optical vector scoring system for
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Hicroprocessor flight control application study	displays to tomorrow's avionics [AIAA 81-2290] Badar hostile fire location A82-13499 BINICOMPUIBES Low cost programmable multisimulator facility [AIAA 81-2229] MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPEE 81-2373] BISSILE CONTIOL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPEE 81-2373] BISSILE CONTIOL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPEE 81-2373] A82-13945
microprocessor applications in piston-prop general avaation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14756	displays to tomorrow's avionics [AIAA 81-2290] Badar hostile fire location A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPEE 81-2373] A82-13945 MISSILE CONTROL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPEE 81-2373] A82-13945 Integrated Plight/Weapon Control design and
microprocessor applications in piston-prop general avaation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for ATCEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14796 MICROWAVE EQUIPMENT	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Radar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 MISSILE CONTION Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 Integrated Plight/Weapon Control design and evaluation
microprocessor applications in piston-prop general avaation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14756	displays to tomorrow's avionics [AIAA 81-2290] Badar hostile fire location A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPEE 81-2373] A82-13945 MISSILE CONTROL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPEE 81-2373] A82-13945 Integrated Plight/Weapon Control design and
microprocessor applications in piston-prop general avaation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14796 MICROWAVE EQUIPMENT High speed microwave phase-locked locps MICROWAVE LANDING SYSTEMS	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 MISSILE CONTROL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 Integrated Plight/Weapon Control design and evaluation A82-14741 MISSILE LAUNCHERS A methodology for missile launch envelope display
microprocessor applications in piston-prop general avaation airplanes [AIAA 81-2330] Flight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for ATCEBS monopulse data processing A82-13908 A multimicroprocessor system for ATCEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14796 MICROWAVE EQUIPMENT High speed microwave phase-locked loops HICROWAVE LANDING SYSTEMS Joint Tactical Microwave Landing System /JIBLS/	displays to tomorrow's avionics [AIAA 81-2290] Badar hostile fire location A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] MISSILE CONTROL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 Integrated Plight/Weapon Control design and evaluation A82-14741
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14796 MICROWAVE EQUIPMENT High speed microwave phase-locked locps A82-14696 MICROWAVE LANDING SYSTEMS Joint Tactical Microwave Landing System /JIBLS/airborne signal processing [AIAA 81-2247] A82-13471	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPDIERS LOW cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 MISSILE CONTROL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 Integrated Plight/Weapon Control design and evaluation A82-14741 MISSILE LAUNCHERS A methodology for missile launch envelope display evaluation A82-14744 MISSILE TESTS
microprocessor applications in piston-prop general avaation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-13908 A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14776 MICROWAVE EQUIPMENT High speed microwave phase-locked locps MICROWAVE LANDING SYSTEMS Joint Tactical Microwave Landing System /JIBLS/ airborne signal processing [AIAA 81-2247] Development of an MLS lateral autoland system with	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPPE 81-2373] A82-13945 MISSILE CONTROL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPPE 81-2373] A82-13945 Integrated Plight/Weapon Control design and evaluation A82-14741 MISSILE LAUNCHERS A methodology for missile launch envelope display evaluation A82-14744 MISSILE TESTS Bayal Weapons Center - Test and evaluation in the
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14796 MICROWAVE EQUIPMENT High speed microwave phase-locked loops MICROWAVE LANDING SYSTEMS Joint Tactical Microwave landing System /JIBLS/ airborne signal processing [AIAA 81-2247] Development of an BLS lateral autoland system with automatic path definition	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 MISSILE CONTROL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 Integrated Plight/Weapon Control design and evaluation A82-14741 MISSILE LAUNCHERS A methodology for missile launch envelope display evaluation A82-14744 MISSILE TESTS Naval Weapons Center - Test and evaluation in the 1980's
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-13908 A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14776 MICROWAVE EQUIPHENT High speed microwave phase-locked loops MICROWAVE LANDING SYSTEMS Joint Tactical Microwave landing System /JINLS/ airborne signal processing [AIAA 81-2247] Development of an MLS lateral autoland system with automatic path definition [AIAA PAPER 81-1751] Computer-animated predictive displays for	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPDIERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 MISSILE CONTROL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 Integrated Plight/Weapon Control design and evaluation A82-14741 MISSILE LAUNCHERS A methodology for missile launch envelope display evaluation A82-14744 MISSILE TESTS Naval Weapons Center - Test and evaluation in the 1980's [AIAA PAPER 81-2485] A82-13940 Pressure distributions on three different
microprocessor applications in piston-prop general avaation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-13908 A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14776 MICROWAVE EQUIPHENT High speed microwave phase-locked loops MICROWAVE LANDING SYSTEMS Joint Tactical Microwave Landing System /JIBLS/ airborne signal processing [AIAA 81-2247] Development of an MLS lateral autoland system with automatic path definition [AIAA PAPEE 81-1751] Computer-animated predictive displays for microwave landing approaches	displays to tomorrow's avionics [AIAA 81-2290] Badar hostile fire location A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPPE 81-2373] A82-13945 MISSILE CONTROL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPPE 81-2373] Integrated Plight/Weapon Control design and evaluation A82-14741 MISSILE LAUNCHERS A methodology for missile launch envelope display evaluation A82-14744 MISSILE TESTS Baval Weapons Center - Test and evaluation in the 1980's [AIAA PAPEE 81-2485] Pressure distributions on three different cruciform aft-tail control surfaces of a
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14796 MICROWAVE EQUIPMENT High speed microwave phase-locked loops MICROWAVE LAWDING SYSTEMS Joint Tactical Microwave Landing System /JIMLS/ airborne signal processing [AIAA 81-2247] Development of an MLS lateral autoland system with automatic path definition [AIAA PAPER 81-1751] Computer-animated predictive displays for microwave landing approaches	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPUIRES Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 MISSILE CONTROL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 Integrated Flight/Weapon Control design and evaluation A82-14741 MISSILE LAUNCHERS A methodology for missile launch envelope display evaluation A82-14744 MISSILE TESTS Naval Weapons Center - Test and evaluation in the 1980's [AIAA PAPER 81-2485] A82-13940 Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70.
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-13908 A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14776 MICROWAVE EQUIPHENT High speed microwave phase-locked loops MICROWAVE LANDING SYSTEMS Joint Tactical Microwave landing System /JIBLS/ airborne signal processing [AIAA 81-2247] Development of an MLS lateral autoland system with automatic path definition [AIAA PAPEE 81-1751] Computer-animated predictive displays for microwave landing approaches A82-15816 MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 MISSILE CONTEOL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 Integrated Plight/Weapon Control design and evaluation A82-14741 MISSILE LAUNCHERS A methodology for missile launch envelope display evaluation A82-14744 MISSILE TESTS Naval Weapons Center - Test and evaluation in the 1980's [AIAA PAPER 81-2485] A82-13940 Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TM-80C97] N82-13110
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14776 MICROWAVE EQUIPMENT High speed microwave phase-locked loops MICROWAVE LANDING SYSTEMS Joint Tactical Microwave landing System /JIMLS/ airborne signal processing [AIAA 81-2247] Development of an MLS lateral autoland system with automatic path definition [AIAA PAPEE 81-1751] Computer-animated predictive displays for microwave landing approaches M82-15816 MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-12061	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPUIRES Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPEE 81-2373] A82-13945 MISSILE CONTIOL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPEE 81-2373] A82-13945 Integrated Plight/Weapon Control design and evaluation A82-14741 MISSILE LAUNCHERS A methodology for missile launch envelope display evaluation A82-14744 MISSILE TESTS Naval Weapons Center - Test and evaluation in the 1980's [AIAA PAPEE 81-2485] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [MASA-TH-80C97] MONITORS
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-13908 A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14776 MICROWAVE EQUIPHENT High speed microwave phase-locked loops MICROWAVE LANDING SYSTEMS Joint Tactical Microwave landing System /JIBLS/ airborne signal processing [AIAA 81-2247] Development of an MLS lateral autoland system with automatic path definition [AIAA PAPEE 81-1751] Computer-animated predictive displays for microwave landing approaches A82-15816 MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 MISSILE CONTEOL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 Integrated Plight/Weapon Control design and evaluation A82-14741 MISSILE LAUNCHERS A methodology for missile launch envelope display evaluation A82-14744 MISSILE TESTS Naval Weapons Center - Test and evaluation in the 1980's [AIAA PAPER 81-2485] A82-13940 Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TM-80C97] N82-13110
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-13908 A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14796 MICROWAVE EQUIPHENT High speed microwave phase-locked loops MICROWAVE LANDING SYSTEMS Joint Tactical Microwave landing System /JIBLS/ airborne signal processing [AIAA 81-2247] Development of an MLS lateral autoland system with automatic path definition [AIAA PAPER 81-1751] Computer-animated predictive displays for microwave landing approaches A82-13993 Computer-animated predictive displays for microwave landing approaches A82-15816 MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] MICROWAVE SWITCHING High speed microwave phase-locked loops	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 MISSILE CONTEOL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 Integrated Plight/Weapon Control design and evaluation A82-14741 MISSILE LAUNCHERS A methodology for missile launch envelope display evaluation A82-14744 MISSILE TESTS Naval Weapons Center - Test and evaluation in the 1980's [AIAA PAPER 81-2485] A82-13940 Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TM-80C97] N82-13110 BONITORS Electronic Master Monitor and Advisory Display System (RMMDS) [AD-A105082] N82-12067
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14796 MICROWAVE EQUIPMENT High speed microwave phase-locked locps MICROWAVE LANDING SYSTEMS Joint Tactical Microwave Ianding System /JIMLS/ airborne signal processing [AIAA 81-2247] Development of an MLS lateral autoland system with automatic path definition [AIAA PAPEE 81-1751] Computer-animated predictive displays for microwave landing approaches MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] MICROWAVE SWITCHING High speed microwave phase-locked locps MILITARY AIRCRAFT	displays to tomorrow's avionics [AIAA 81-2290] Badar hostile fire location A82-13499 Badar hostile fire location A82-14857 MINICOMPUIRES Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 MISSILE CONTROL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 Integrated Plight/Weapon Control design and evaluation A82-14741 MISSILE LAUNCHERS A methodology for missile launch envelope display evaluation A82-14744 MISSILE TESTS Naval Weapons Center - Test and evaluation in the 1980's [AIAA PAPER 81-2485] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TH-80C97] M82-13110 M82-13110 M82-13110 M82-1310 M82-1300PULSE BADAR
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICEBS monopulse data processing A82-13908 A multimicroprocessor system for AICEBS monopulse data processing A82-14777 Microprocessor flight control application study A82-14796 MICROWAVE EQUIPHENT High speed microwave phase-locked loops MICROWAVE LANDING SYSTEMS Joint Tactical Microwave landing System /JIBLS/ airborne signal processing [AIAA 81-2247] Development of an MLS lateral autoland system with automatic path definition [AIAA PAPER 81-1751] Computer-animated predictive displays for microwave landing approaches A82-13993 Computer-animated predictive displays for microwave landing approaches A82-15816 MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] MICROWAVE SWITCHING High speed microwave phase-locked loops	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 MISSILE CONTEOL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 Integrated Plight/Weapon Control design and evaluation A82-14741 MISSILE LAUNCHERS A methodology for missile launch envelope display evaluation A82-14744 MISSILE TESTS Naval Weapons Center - Test and evaluation in the 1980's [AIAA PAPER 81-2485] A82-13940 Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TM-80C97] N82-13110 BONITORS Electronic Master Monitor and Advisory Display System (RMMDS) [AD-A105082] N82-12067
microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] Plight testing De Havilland Aircraft Limited DASH-8 utilizing onboard data analysis by microprocessor [AIAA PAPER 81-2507] Application of a microprocessor controlled cockpit display for enhanced pilot control of flight test maneuvers [AIAA PAPER 81-2510] A multimicroprocessor system for AICABS monopulse data processing A82-14777 Microprocessor flight control application study A82-14796 MICROWAVE EQUIPMENT High speed microwave phase-locked locps MICROWAVE LANDING SYSTEMS Joint Tactical Microwave Landing System /JINLS/ airborne signal processing [AIAA 81-2247] Development of an MLS lateral autoland system with automatic path definition [AIAA PAPEE 81-1751] Computer-animated predictive displays for microwave landing approaches A82-15816 MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] MICROWAVE SWITCHING High speed microwave phase-locked locps A82-14696 MILITARY AIRCRAPT Heavy lift helicopters - A national technology	displays to tomorrow's avionics [AIAA 81-2290] A82-13499 Badar hostile fire location A82-14857 MINICOMPUTERS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 MISS DISTANCE Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 MISSILE CONTROL Electro-optical vector scoring system for missile miss distance in fleet training exercises [AIAA FAPER 81-2373] A82-13945 Integrated Plight/Weapon Control design and evaluation A82-14741 MISSILE LAUNCHERS A methodology for missile launch envelope display evaluation A82-14744 MISSILE TESTS Naval Weapons Center - Test and evaluation in the 1980's [AIAA PAPER 81-2485] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [MASA-TH-80097] N82-13110 MONITORS Electronic Master Monitor and Advisory Display System (EMMADS) [AD-A105082] MONOPULSE BADAR Performance evaluation of target report extractor

MOVING TARGET INDICATORS	BASA PROGRAMS
Pave Mover Flight Test Program [AIAA PAPER 81-2492] A82-14380	Progress in aeronautical research and technology applicable to civil air transports
Some Italian research for developing new primary	A82-13974
ATC radars	HAVIER-STOKES EQUATION
A82-14775	Prediction of subsonic aircraft flows with jet
Air-to-ground MII radar using a displaced phase	exhaust interactions N82-13096
center, phased array A82-14881	Numerical analysis of the scramjet-inlet flow
Moving target Detector/Airport Surveillance radar	field by using two-dimensional Navier-Stokes
(ASR-7) field evaluation	equations
[AD-A105196] N82-12303	[NASA-TP-1940] N82-13142
MRCA AIRCRAFT A technique to determine lift and drag polars in	BAVIGATION AIDS Time-referencing of data in an asynchronous
flight and their application	environment for fighter aircraft avionics
[AIAA PAPEE 81-2420] A82-13859	[AIAA 81-2341] A82-13531
The design and development of the Tornado engine	Estimation of the efficiency of radioelectronic
air intake	flight navigation systems
N82-13074 The subsonic performance of practical military	A82-13701 Plight evaluation of LOBAN-C as a helicopter
variable area convergent nozzles	navigation aid in the Baltimore Canyon oil
N82-13076	exploration area
MULTIPLEXING	[AD-A105260] N82-12059
A polled contention multiplex system using	NAVIGATION INSTRUMENTS
MIL-STD-1553 protocol [AIAA 81-2271] A82-13487	A Loran-C prototype mavigation receiver for general aviation
Advanced fiber optic systems for avicuics	[AIAA 81-2329] A82-13532
applications	Applications of covariance analysis simulation to
[AIAA 81-2319] A82-13518	avionics flight testing
Techniques for interfacing multiplex systems [AD-A101457] B82-13135	NAVSTAR SATELLITES
MULTIPROCESSING (COMPUTERS)	Navstar Global Positioning System flight test
Lockheed Airborne Data System - Distributed	program overview
microcomputers provide on-board real-time analysis	[AIAA PAPER 81-2350] A82-13956
[AIAA PAPER 81-2367] A82-13949	Passive terrain following using stored map and
A multimicroprocessor system for ATCEBS monopulse data processing	global positioning system A82-14772
A82-14777	BAVY
	U.S. Navy life support development trends
N	A82-14952
NACELLES	HASEP - Survival from crashed Navy helicopters
Aerodynamics of Power Plant Installation	A82-14977 A summary of the Naval Postgraduate School
[AGARD-CP-301] N82-13065	Research Program
Model testing techniques for measuring inlet drag	[AD-A104112] N82-13975
N82-13084	BEAR WAKES
The role and implementation of different nacelle/engine simulation concepts for	Theoretical analysis of wake-induced parachute collapse
wind-tunnel testing in research and development	[AIAA PAPER 81-1922] A82-13963
work on transport alreraft	NEODYMIUM LASERS
N82-13086	Options for GTE precision automated tracking system
Wind tunnel tests of powered models: A comparison	alrborne laser tracking system
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet	airborne laser tracking system 182-13020
Wind tunnel tests of powered models: A comparison	airborne läser tracking system A82-13020 BETERBLANDS
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using	airborne läser tracking system A82-13020 BETERBLANDS Orienting description of air traffic control in the Netherlands
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle	airborne läser tracking system A82-13020 **BETHERLANDS** Orienting description of air traffic control in the Netherlands [VTH-LR-285] N82-12063
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment	airborne läser tracking system A82-13020 WETHERLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] N82-12063 WETHORK SYNTHESIS
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088	airborne laser tracking system A82-13020 BETERBLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] N82-12063 BETWORK SYBTHESIS Conceptual design of an integrated power and
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed	airborne läser tracking system A82-13020 WETHERLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] N82-12063 WETHORK SYNTHESIS
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe	airborne läser tracking system A82-13020 WETEBBLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] NETWORK SYSTESIS Conceptual design of an integrated power and avionics information system A82-14788
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with	airborne läser tracking system A82-13020 BETHEBLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] N82-12063 BETWORK SYMTHESIS Conceptual design of an integrated power and avionics information system A82-14788 NEW JERSEY Flight evaluation of LORAN-C as a helicopter
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators	airborne laser tracking system A82-13020 BETERBLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] N82-12063 BETWORK SYBTHESIS Conceptual design of an integrated power and avionics information system A82-14788 BEW JERSEY Flight evaluation of LORAN-C as a helicopter navigation aid in the Baltimore Canyon oil
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with	airborne laser tracking system A82-13020 BETERBLANDS Orienting description of air traffic control in the Netherlands [VTH-1R-285] BETWORK SYETHESIS Conceptual design of an integrated power and avionics information system A82-14788 BEN JERSEY Flight evaluation of LOBAN-C as a helicopter navigation aid in the Baltimore Canyon oil exploration area
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators Evaluation of an experimental technique to investigate the effects of the engine position	airborne laser tracking system A82-13020 BETERBLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] BETWORK SYETHESIS Conceptual design of an integrated power and avionics information system A82-14788 BEN JERSEY Flight evaluation of LOBAN-C as a helicopter navigation aid in the Baltimore Canyon oil exploration area
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators N82-13089 Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference	airborne laser tracking system A82-13020 BETERBLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] BETWORK SYBTHESIS Conceptual design of an integrated power and avionics information system A82-14788 BEW JERSEY Flight evaluation of LORAN-C as a helicopter navigation aid in the Baltimore Canyon oil exploration area [AD-A105260] N82-12059 BIGHT VISION The TADS/FNVS 'eyes' for the AH-64 attack belicopter
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators N82-13089 Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference	HETBEBLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] NETWORK SYMPRESIS Conceptual design of an integrated power and avionics information system NBW JERSEY Flight evaluation of LORAN-C as a helicopter navigation aid in the Baltimore Canyon oil exploration area [AD-A105260] N82-12059 NIGHT VISION The TADS/FNVS 'eyes' for the AH-64 attack helicopter A82-13239
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators N82-13089 Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference	airborne läser tracking system A82-13020 WETHERLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] NETWORK SINTHESIS Conceptual design of an integrated power and avionics information system A82-14788 BEN JERSEY Flight evaluation of LOBAN-C as a helicopter navigation aid in the Baltimore Canyon oil exploration area [AD-A105260] N82-12059 WIGHT VISION The TADS/FNVS 'eyes' for the AH-64 attack helicopter A82-13239 The LANTIRN wide field-of-view raster Head-Up
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators N82-13089 Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference N82-13090 The influence of closed-coupled, rear fuselage mounted nacelles on the design of an advanced high speed wing	HETBEBLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] NETWORK SYMPRESIS Conceptual design of an integrated power and avionics information system NBW JERSEY Flight evaluation of LORAN-C as a helicopter navigation aid in the Baltimore Canyon oil exploration area [AD-A105260] N82-12059 NIGHT VISION The TADS/FNVS 'eyes' for the AH-64 attack helicopter A82-13239
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators N82-13089 Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference N82-13090 The influence of closed-coupled, rear fuselage mounted nacelles on the design of an advanced high speed wing	HETEBLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] NETWORK SYSTEESIS Conceptual design of an integrated power and avionics information system NEW JERSEY Flight evaluation of LORAN-C as a helicopter navigation aid in the Baltimore Canyon oil exploration area [AD-A105260] N82-12059 HIGHT VISION The TADS/FNVS 'eyes' for the AH-64 attack helicopter A82-13239 The LANTIEN wide field-of-view raster Head-Up Display Low Altitude Navigation and Targeting IR for Night
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference N82-13090 The influence of closed-coupled, rear fuselage mounted nacelles on the design of an advanced high speed wing N82-13092 Aerodynamic aspects of a high bypass ratio engine	### ### ##############################
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators N82-13089 Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference N82-13090 The influence of closed-coupled, rear fuselage mounted nacelles on the design of an advanced high speed wing N82-13092 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody	### ##################################
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference N82-13090 The influence of closed-coupled, rear fuselage mounted nacelles on the design of an advanced high speed wing N82-13092 Aerodynamic aspects of a high bypass ratio engine	### ### ##############################
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference N82-13090 The influence of closed-coupled, rear fuselage mounted nacelles on the design of an advanced high speed wing N82-13092 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody N82-13093 A numerical method for studying nacelle-jet-airfoil interaction in inviscid	### ### ##############################
Wind tunnel tests of powered models: A comprison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators N82-13089 Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference N82-13090 The influence of closed-coupled, rear fuselage mounted nacelles on the design of an advanced high speed wing N82-13092 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody N82-13093 A numerical method for studying nacelle-jet-airfoil interaction in inviscid three-dimensional flow	### ### ##############################
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators N82-13089 Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference N82-13090 The influence of closed-coupled, rear fuselage mounted nacelles on the design of an advanced high speed wing N82-13092 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody N82-13093 A numerical method for studying nacelle-jet-airfoil interaction in inviscid three-dimensional flow	HETBERLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] NETWORK SYSTRESIS Conceptual design of an integrated power and avionics information system NEW JERSEY Flight evaluation of LORAN-C as a helicopter navigation aid in the Baltimore Canyon oil exploration area [AD-A105260] N82-12059 HIGHT VISION The TADS/FNVS 'eyes' for the AH-64 attack helicopter A82-13239 The LANTIEN wide field-of-view raster Head-Up Display Low Altitude Navigation and Targeting IR for Night A82-14825 Experimental investigation of a helmet mounted sight/display for helicopter N82-13060 NITBOGEN OXIDES Effect of fuel-air-ratio nonuniformity on emissions of nitrogen oxides [NASA-TP-1798] N82-13143
Wind tunnel tests of powered models: A comprison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators N82-13089 Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference N82-13090 The influence of closed-coupled, rear fuselage mounted nacelles on the design of an advanced high speed wing N82-13092 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody N82-13093 A numerical method for studying nacelle-jet-airfoil interaction in inviscid three-dimensional flow	HETEBLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] NETWORK SYMPRESIS Conceptual design of an integrated power and avionics information system NEW JEESEY Flight evaluation of LORAN-C as a helicopter navigation aid in the Baltimore Canyon oil exploration area [AD-A105260] N82-12059 HIGHT VISION The TADS/FNVS 'eyes' for the AH-64 attack helicopter A82-13239 The LANTIRN wide field-of-view raster Head-Up Display Low Altitude Navigation and Targeting IR for Night A82-14825 Experimental investigation of a helmet mounted sight/display for helicopter NITEOGEN OXIDES Effect of fuel-air-ratio nonuniformity on emissions of nitrogen oxides [NASA-TP-1798] NOISE POLIUTION
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators N82-13089 Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference N82-13090 The influence of closed-coupled, rear fuselage mounted nacelles on the design of an advanced high speed wing N82-13092 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody N82-13093 A numerical method for studying nacelle-jet-airfoil interaction in inviscid three-dimensional flow N82-13094 Airframe-propulsion system aerodynamic interference predictions at high transonic Mach numbers including cff-design engine airflow	HETBERLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] NETWORK SYSTRESIS Conceptual design of an integrated power and avionics information system NEW JERSEY Flight evaluation of LORAN-C as a helicopter navigation aid in the Baltimore Canyon oil exploration area [AD-A105260] N82-12059 HIGHT VISION The TADS/FNVS 'eyes' for the AH-64 attack helicopter A82-13239 The LANTIEN wide field-of-view raster Head-Up Display Low Altitude Navigation and Targeting IR for Night A82-14825 Experimental investigation of a helmet mounted sight/display for helicopter N82-13060 NITBOGEN OXIDES Effect of fuel-air-ratio nonuniformity on emissions of nitrogen oxides [NASA-TP-1798] N82-13143
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators N82-13089 Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference N82-13090 The influence of closed-coupled, rear fuselage mounted nacelles on the design of an advanced high speed wing N82-13092 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody N82-13093 A numerical method for studying nacelle-jet-airfoil interaction in inviscid three-dimensional flow N82-13094 Airframe-propulsion system aerodynamic interference predictions at high transonic Mach numbers including cff-design engine airflow effects	HETBERLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] N82-12063 NETWORK SYSTRESIS Conceptual design of an integrated power and avionics information system NEW JERSEY Flight evaluation of LORAN-C as a helicopter navigation aid in the Baltimore Canyon oil exploration area [AD-A105260] N82-12059 HIGHT VISION The TADS/FNVS 'eyes' for the AH-64 attack helicopter A82-13239 The LANTIEN wide field-of-view raster Head-Up Display Low Altitude Navigation and Targeting IR for Night A82-14825 Experimental investigation of a helmet mounted sight/display for helicopter N82-13060 NITBOGEN OXIDES Effect of fuel-air-ratio nonuniformity on emissions of nitrogen oxides [NASA-TP-1798] NOISE POLIUTION Costs of noise nuisance from aircraft NOISE PREDICTION (AIRCRAFT)
Wind tunnel tests of powered models: A comprison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators N82-13089 Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference N82-13090 The influence of closed-coupled, rear fuselage mounted nacelles on the design of an advanced high speed wing N82-13092 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody N82-13093 A numerical method for studying nacelle-jet-airfoil interaction in inviscid three-dimensional flow N82-13094 Airframe-propulsion system aerodynamic interference predictions at high transonic Mach numbers including cff-design engine airflow effects	### ### ##############################
Wind tunnel tests of powered models: A comparison of two methods of simulating the jets of jet engines N82-13087 Wind tunnel test and analysis techniques using powered simulators for civil nacelle installation drag assessment N82-13088 Establishment of an experimental technique to provide accurate measurement of the installed drag of close coupled civil nacelle/airframe configurations, using a full span model with turbine powered engine simulators N82-13089 Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylon/wing interference N82-13090 The influence of closed-coupled, rear fuselage mounted nacelles on the design of an advanced high speed wing N82-13092 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody N82-13093 A numerical method for studying nacelle-jet-airfoil interaction in inviscid three-dimensional flow N82-13094 Airframe-propulsion system aerodynamic interference predictions at high transonic Mach numbers including cff-design engine airflow effects	HETBERLANDS Orienting description of air traffic control in the Netherlands [VTH-LR-285] N82-12063 NETWORK SYSTRESIS Conceptual design of an integrated power and avionics information system NEW JERSEY Flight evaluation of LORAN-C as a helicopter navigation aid in the Baltimore Canyon oil exploration area [AD-A105260] N82-12059 HIGHT VISION The TADS/FNVS 'eyes' for the AH-64 attack helicopter A82-13239 The LANTIEN wide field-of-view raster Head-Up Display Low Altitude Navigation and Targeting IR for Night A82-14825 Experimental investigation of a helmet mounted sight/display for helicopter N82-13060 NITBOGEN OXIDES Effect of fuel-air-ratio nonuniformity on emissions of nitrogen oxides [NASA-TP-1798] NOISE POLIUTION Costs of noise nuisance from aircraft NOISE PREDICTION (AIRCRAFT)

NOISE REDUCTION	OPPSHORE ENERGY SOURCES
Aircraft abscrbers - Promise and practice	Plight evaluation of LOBAN-C as a helicopter
sound attenuation	
	navigation and in the Baltimore Canyon oil
	14042 exploration area
Analysis of integrated fuel-efficient, low-nois	se [AD-A105260] N82-126
procedures in terminal-area operations	OIL ADDITIVES
	13014 Optimization of requirements on the
NONDESTRUCTIVE TESTS	pitting-prevention properties of turbojet-engine
In-service inspection methods for graphite-epox	v oils
ctructures on conversion to grapher of	
structures on commercial transport aircraft	A82-15
[NASA-CR-165746] N82-	12142 ONEGA NAVIGATION SYSTEM
NOBLIBEAR SYSTEMS	Updated station deselection procedures to support
The design of exact nonlinear model followers -	
with application to trajectory autopilot for	A82-14
helicopter	ONBOARD DATA PROCESSING
	13125 Plight testing De Havilland Aircraft Limited
An approach to robust nonlinear control design	DASH-8 utilizing onboard data analysis by
with illustration of J-85 turbojet engine	BlCroprocessor
simulation	[AIAA PAPER 81-2507] A82-139
	13128 Lockheed Airborne Data System - Distributed
Application of the concept of dynamic trim cont	rol microcomputers provide on-board real-time analy:
and nonlinear system inverses to automatic	[AIAA PAPER 81-2367] A82-13
control of a vertical attitude takeoff and	ONBOARD EQUIPMENT
control of a vertical attitude takeoff and	<u>-</u>
landing arrcraft	Botor systems research aircraft /RSRA/ rotor force
[AIAA 81-2238] A82-	13466 and moment measurement system
Integrated flight testing based on nonlinear	
system identification data processing techniq	ues Design study report for General Aviation Loran-C
[AIAA PAPEE, 81-2449] A82-	14389 receiver
HONUNIPORM PLON	[AD-A104921] N82-12
Effect of fuel-air-ratic nonuniformity on	OPERATING COSTS
emissions of nitrogen oxides	A new approach to modeling the cost of ownership
	13143 for aircraft systems
NOSE INLETS	[AD-A104434] N82-13
Thrust modulation methods for a subscnic V/STOL	OPERATING TEMPERATURE
aircraft	The operational characteristics of turbojets,
[NASA-TM-82747] N82-	·13112 giving particular attention to the cooled
NOZZLB DESIGN	high-pressure turbine
Integration of advanced exhaust nozzles	A82-14
	·13075 OPTICAL COMMUNICATION
The subsonic performance of practical military	Light-guided information distribution systems
variable area convergent nozzles	[AIAA 81-2320] A82-13
	13076 OPTICAL BADAR
Advanced exhaust nozzle technology	Options for GTB precision automated tracking system
N82-	13078 alrborne laser tracking system
NOGGIO DODICIDUCA	
HOZZLE EPPICIBNCY	A82-13
Comparison of different nozzle concepts for a	OPTICAL TRACKING
Comparison of different nozzle concepts for a reheated turbofan	A82-130 OPTICAL TRACKING ATARK laser tracking system
Comparison of different nozzle concepts for a reheated turbofan N82-	OPTICAL TRACKING ATARK laser tracking system 13077 A82-130
Comparison of different nozzle concepts for a reheated turbofan	A82-130 OPTICAL TRACKING ATARK laser tracking system
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology	OPTICAL TRACKING ATARK laser tracking system A82-13077 Experimental investigation of a helmet mounted
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology N82-	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted 13078 sight/display for helicopter
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology N82- NOZZLE GEOMETRY	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-13
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology N82- NOZZLE GEOMETRY The subsonic performance of practical military	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter OPTICAL WAVEGUIDES A82-136 N82-137
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology N82- NOZZLE GEOMETRY The subsonic performance of practical military	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter OPTICAL WAVEGUIDES A82-136 N82-137
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted 13078 sight/display for helicopter N82-136 OPTICAL WAVEGUIDES Light-guided information distribution systems
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology N82- NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles N82-	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-130 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] A82-13
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology N82- NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles N82- NOZZLE THRUST CORFFICIENTS	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-130 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIBAL CONTROL
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology N82- NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles N82- NOZZLE THRUST CORFFICIENTS	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-130 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIBAL CONTROL
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles NOZZLE THRUST CORFFICIENTS Thrust modulation methods for a subscnic V/STOL	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-13 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIMAL CONTROL Digital control for flexible aircraft using
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles NOZZLE THRUST COEFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-136 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIMAL CONTROL Digital control for flexible aircraft using reduced order models
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology N82- NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles N82- NOZZLE THRUST COEFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft [NASA-TM-82747] N82-	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-130 OPTICAL WAVEGUIDES Light-quided information distribution systems [AIAA 81-2320] OPTIMAL CONTROL Digital control for flexible aircraft using reduced order models 13112
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles NOZZLE THRUST COEFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-136 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIMAL CONTROL Digital control for flexible aircraft using reduced order models
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology N82- NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles N82- NOZZLE THRUST COEFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft [NASA-TH-82747] N82- NUMERICAL ANALYSIS	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-130 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIMAL CONTEOL Digital control for flexible aircraft using reduced order models 13112 On-line optimization of aircraft altitude and
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles NOZZLE THRUST COEFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft [NASA-TH-82747] NOMERICAL ANALYSIS Air-to-air combat analysis - Review of	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-13 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIMAL CONTROL Digital control for flexible aircraft using reduced order models 13112 On-line optimization of aircraft altitude and flight path angle dynamics
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles NOZZLE THBUST COEFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft [NASA-TH-82747] NUMERICAL ANALYSIS Air-to-air combat analysis - Review of differential-gaming approaches	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-130 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIMAL CONTROL Digital control for flexible aircraft using reduced order models 13112 On-line optimization of aircraft altitude and flight path angle dynamics A82-13
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology N82- NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles N82- NOZZLE THRUST COEFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft [NASA-TM-82747] N82- NUMERICAL ANALYSIS Air-to-air combat analysis - Review of differential-gaming approaches	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-130 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAN 81-2320] OPTIMAL CONTROL Digital control for flexible aircraft using reduced order models 13112 On-line optimization of aircraft altitude and flight path angle dynamics A82-13 Application of singular perturbation theory
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles NOZZLE THBUST COEFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft [NASA-TH-82747] NUMERICAL ANALYSIS Air-to-air combat analysis - Review of differential-gaming approaches	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-130 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIMAL CONTROL Digital control for flexible aircraft using reduced order models 13112 On-line optimization of aircraft altitude and flight path angle dynamics A82-13
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology N82- N82- N82- N82- N82- N82- N82- N82	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-13: OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIMAL CONTROL Digital control for flexible aircraft using reduced order models 13112 On-line optimization of aircraft altitude and flight path angle dynamics A82-13: Application of singular perturbation theory N82-12:
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles NOZZLE THRUST COEFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft [NASA-TH-82747] NUMERICAL ANALYSIS Air-to-air combat analysis - Review of differential-gaming approaches NUMERICAL COETROL Parallel processing applied to digital flight	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-13 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIMAL CONTROL Digital control for flexible aircraft using reduced order models 13112 On-line optimization of aircraft altitude and flight path angle dynamics A82-13 Application of singular perturbation theory N82-12 Computational methods of robust controller design
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles NOZZLE THRUST COEFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft [NASA-TH-82747] NUMERICAL ANALYSIS Air-to-air combat analysis - Review of differential-gaming approaches NUMERICAL COETROL Parallel processing applied to digital flight	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-136 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIBAL CONTROL Digital control for flexible aircraft using reduced order models 13112 On-line optimization of aircraft altitude and flight path angle dynamics A82-13 Application of singular perturbation theory Computational methods of robust controller design for aerodynamic flutter suppression
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles NOZZLE THRUST COEFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft [NASA-TH-82747] NUMERICAL ANALYSIS Air-to-air combat analysis - Review of differential-gaming approaches NUMERICAL CONTROL Parallel processing applied to digital flight control systems - Some perspectives	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-13 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIMAL CONTROL Digital control for flexible aircraft using reduced order models 13112 On-line optimization of aircraft altitude and flight path angle dynamics A82-13 Application of singular perturbation theory N82-12 Computational methods of robust controller design
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology N82- NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles N82- NOZZLE THRUST COEFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft [NASA-TM-82747] NUMERICAL ANALYSIS Air-to-air combat analysis - Review of differential-gaming approaches NUMERICAL COUTROL Parallel processing applied to digital flight control systems - Some perspectives	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter N82-13: OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIMAL CONTEOL Digital control for flexible aircraft using reduced order models 13112 On-line optimization of aircraft altitude and flight path angle dynamics A82-13 Application of singular perturbation theory Computational methods of robust controller design for aerodynamic flutter suppression [NASA-CR-164983] N82-12
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Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles NOZZLE THBUST COEFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft [NASA-TH-82747] NUMERICAL ANALYSIS Air-to-air combat analysis - Review of differential-gaming approaches NUMERICAL COUTROL Parallel processing applied to digital flight control systems - Same perspectives Microprocessor flight control application study A82- NUMERICAL FLOW VISUALIZATION The numerical solution of incompressible turbul flow over airfoils N82- OBLIQUE BINGS AD-1 oblique wing aircraft program [AIAA PAPES 81-2354] OBSERVABILITY (SYSTEMS) The use of observers on relaxed static stabilit aircraft OCEANOGEAPHY	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter 13078 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIMIA CONTROL Digital control for flexible aircraft using reduced order models 13112 On-line optimization of aircraft altitude and flight path angle dynamics 13115 Application of singular perturbation theory 14794 Computational methods of robust controller design for aerodynamic flutter suppression [NASA-CR-164983] OPTIMIZATION Flight vibration optimization via conformal mapping and airflow distribution for gas turbine confustors OSCILLATIONS Analysis of a longitudinal pilot-induced oscillation experienced on the approach and landing test of the space shuttle [NASA-TM-81366] PABEL BETHOD (FLUID DYNAMICS)
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles NOZZLE THRUST CORFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft [NASA-TM-82747] NUMERICAL ANALYSIS Air-to-air combat analysis - Review of differential-gaming approaches NUMERICAL COUTROL Parallel processing applied to digital flight control systems - Same perspectives Microprocessor flight control application study A82- Microprocessor flight control application study A82- NUMERICAL FLOW VISUALIZATION The numerical solution of incompressible turbul flow over airfoils N82- O OBLIQUE NINGS AD-1 oblique wing aircraft program [AIAA PAPER 81-2354] OBSBRVABILITY (SYSTEMS) The use of observers on relaxed static stabilit aircraft OCEANOGRAPHY A summary of the Naval Postgraduate School	OPTICAL TRACKING ATARK laser tracking system Experimental investigation of a helmet mounted sight/display for helicopter OPTICAL MAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIMAL CONTROL Digital control for flexible aircraft using reduced order models A82-13 On-line optimization of aircraft altitude and flight path angle dynamics A82-13 Application of singular perturbation theory N82-12 Computational methods of robust controller design for aerodynamic flutter suppression [NASA-CR-164983] OPTIMIZATION Flight vibration optimization via conformal mappi A82-13 ORIFICE FLOW Experimental investigation of total pressure loss and airflow distribution for gas turbine combustors OSCILLATICES Analysis of a longitudinal pilot-induced oscillation experienced on the approach and landing test of the space shuttle [NASA-TE-81366] PANEL BETHOD (FLUID DYNAMICS) A numerical method for studying
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology NOZZLE GEOMETRY The subsonic performance of practical military variable area convergent nozzles NOZZLE THBUST COEFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft [NASA-TH-82747] NUMERICAL ANALYSIS Air-to-air combat analysis - Review of differential-gaming approaches NUMERICAL COUTROL Parallel processing applied to digital flight control systems - Same perspectives Microprocessor flight control application study A82- NUMERICAL FLOW VISUALIZATION The numerical solution of incompressible turbul flow over airfoils N82- OBLIQUE BINGS AD-1 oblique wing aircraft program [AIAA PAPES 81-2354] OBSERVABILITY (SYSTEMS) The use of observers on relaxed static stabilit aircraft OCEANOGEAPHY	OPTICAL TRACKING ATARK laser tracking system 13077 Experimental investigation of a helmet mounted sight/display for helicopter 13078 OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIMIA CONTROL Digital control for flexible aircraft using reduced order models 13112 On-line optimization of aircraft altitude and flight path angle dynamics 13115 Application of singular perturbation theory 14794 Computational methods of robust controller design for aerodynamic flutter suppression [NASA-CR-164983] OPTIMIZATION Flight vibration optimization via conformal mapping and airflow distribution for gas turbine confustors OSCILLATIONS Analysis of a longitudinal pilot-induced oscillation experienced on the approach and landing test of the space shuttle [NASA-TM-81366] PABEL BETHOD (FLUID DYNAMICS)
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology NOZZLE GBONETRY The subsonic performance of practical military variable area convergent nozzles NOZZLE THRUST COEFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft [NASA-TH-82747] NUMERICAL ANALYSIS Air-to-air combat analysis - Review of differential-gaming approaches NUMERICAL CONTROL Parallel processing applied to digital flight control systems - Some perspectives Microprocessor flight control application study NUMERICAL PLOW VISUALIZATION The numerical solution of incompressible turbul flow over airfoils OOBLIQUE NINGS AD-1 oblique wing aircraft program [AIAA PAPES 81-2354] OBSERVABILITY (SISTEMS) The use of observers on relaxed static stabilit aircraft A summary of the Naval Postgraduate School Research Program	OPTICAL TRACKING ATARK laser tracking system Experimental investigation of a helmet mounted sight/display for helicopter OPTICAL WAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] A82-13 OPTIMAL CONTROL Digital centrol for flexible aircraft using reduced order models A82-13 On-line optimization of aircraft altitude and flight path angle dynamics A82-13 Application of singular perturbation theory Computational methods of robust controller design for aerodynamic flutter suppression [AIA794 (NASA-CR-164983) N82-12 OPTIMIZATION Flight vibration optimization via conformal mappi A82-13 ORIFICE FLOW Experimental investigation of total pressure loss and airflow distribution for gas turbine combustors OSCILLATIONS Analysis of a longitudinal pilot-induced oscillation experienced on the approach and landing test of the space shuttle [NASA-TB-81366] N82-13 PANEL BETHOD (PLUID DYNAMICS) A numerical method for studying nacelle-jet-airfoil interaction in inviscid
Comparison of different nozzle concepts for a reheated turbofan N82- Advanced exhaust nozzle technology NOZZLE GBONBTRY The subsonic performance of practical military variable area convergent nozzles NOZZLE THRUST CORFFICIENTS Thrust modulation methods for a subscnic V/STOL aircraft [NASA-TH-82747] NUMERICAL ANALYSIS Air-to-air combat analysis - Review of differential-gaming approaches NUMERICAL CONTROL Parallel processing applied to digital flight control systems - Some perspectives Microprocessor flight control application study NUMERICAL PLOW VISUALIZATION The numerical solution of incompressible turbul flow over airfoils OOBLIQUE NINGS AD-1 oblique wing aircraft program [AIAA PAPES 81-2354] OBSERVABILITY (SYSTEMS) The use of observers on relaxed static stabilit aircraft A summary of the Naval Postgraduate School Research Program	OPTICAL TRACKING ATARK laser tracking system Experimental investigation of a helmet mounted sight/display for helicopter OPTICAL MAVEGUIDES Light-guided information distribution systems [AIAA 81-2320] OPTIMAL CONTROL Digital control for flexible aircraft using reduced order models A82-13 On-line optimization of aircraft altitude and flight path angle dynamics A82-13 Application of singular perturbation theory N82-12 Computational methods of robust controller design for aerodynamic flutter suppression [NASA-CR-164983] OPTIMIZATION Flight vibration optimization via conformal mappi A82-13 ORIFICE FLOW Experimental investigation of total pressure loss and airflow distribution for gas turbine combustors OSCILLATICES Analysis of a longitudinal pilot-induced oscillation experienced on the approach and landing test of the space shuttle [NASA-TE-81366] PANEL BETHOD (FLUID DYNAMICS) A numerical method for studying

PARABOLIC ANTENNAS		Experimental and analytical studies of ad	ivanced .
Prediction and performance of radome-cove reflector antennas	red	air cushion landing systems	N82-12065
	A82-15311	[NASA-CR-3476] Simulator certification methods and the v	
PARABOLIC REFLECTORS		notion simulator	
Prediction and performance of radome-cove reflector antennas	rea	[NASA-CR-166252] PERFORMANCE TESTS	N82-12082
	A82-15311	A decoupled control system for improved f	light
PARACHUTE DESCRIPT Theoretical analysis of wake-induced para	chuto	performance in wind shear	A82-13079
collapse	Cadre	Helicopter icing	HO2-130/9
[AIAA PAPEE 81-1922]	A82-13963	•	A82-13243
Escape systems decelerator technology [AIAA PAPER 81-1913]	A82-13966	C-5A unsurfaced taxi and off-load demonst [AIAA PAPER 81-2439]	Rations A82-13875
Automatic parachute releasers for premedi	tated	Performance assessment of an advanced reb	
parachuting	A82-14960	turbo fan engine [AIAA PAPEE 81-2447]	A82-13879
PARACEUTES		Planning a helicopter flight test program	
The Air Force Flight Test Center - Utah T Training Range in the 1980's	est and	[AIAA PAPER 81-2381] The Air Porce Plight Test Center - Utah T	A82-13881
[AIAA PAPER 81-2487]	A82-13916	Training Range in the 1980's	est and
Development of a lifting parachute to pro		[AIAA PAPER 81-2487]	A82-13916
self-dispersing capability for an Avco- tactical munition	designed	A unique integrated flight testing facili advanced control/display research	ty for
[AIAA PAPER 81-1928]	A82-13962	[AIAA PAPER 81-2490]	A82-13919
The history of the development of the GQ aeroconical parachute - 1971-1980		P/A-18 Flight Test program overview ~ 1 S 1981	eptember
·	A82-14961	[AIAA PAPER 81-2351]	A82-13955
Further test results of parachutes with a inflation mcdulation /A.I.M./	utomatic	Development of a lifting parachute to pro	
	A82-14965	self-dispersing capability for an Avco- tactical munition	designed
A look at the Hoffman Triangular parachute first successful glidable parachute	e - The	[AIAA PAPER 81-1928]	A82-13962
iiist Successial gildable palacaute	A82-14966	Theoretical analysis of wake-induced para collapse	Chute
Post ejection survival	100 44004	[AIAA FAPER 81-1922]	A82-13963
PARALLEL PROCESSING (COMPUTERS)	A82-14981	Testing capabilities of the 3246th Test W [AIAA PAPER 81~2484]	a82-14387
Parallel processing applied to digital fl	ight	Advanced fighter technology integration A	
control systems - Scme perspectives	882-14794	test program overview [AIAA FAPER 81~2353]	A82-14398
PARAMETER IDENTIFICATION		A concept for a high-accuracy, low-cost	802 14330
On matching the systems identification ter to the particular application in evo		accelerometer	A82-14685
flight test data	azuacing	Testing of the SJU-5A ejection seat for t	
Determining hinge moments and empennage a	A82-13119	/HCRNET/ aircraft	100 40055
parameters from flight data for Learjet		Test and evaluation of improved aircrew r	A82-14955 estraint
	A82-13120	systems	
Computational considerations for fusion in identification systems multisensor of		Performance assessment of the ACES-II eje	A82-14974 ction
m)	A82-14735	seat-A-10 configuration	
The agile transversal filter - A flexible block for ICNIA Integrated Communication		Analytical and experimental characterizat	A82-14980
Navigation and Identification Avionics	•	the JAU-14/A cartridge actuated initiat	or for
Application of multiple model estimation	A82-14765	use in aircrew escape system performanc evaluation	e
techniques to a recursive terrain beight	t		A82-14985
correlation system	A82-14768	PERTURBATION THEORY	
System identification helicopter parameter		Comparison between the exact and an appro feedback solution for medium range inte	rception
Determination from flight tests, phase (BMVG-PBWT-80-12)	2 N82-13137	problems	
PASSENGER AIRCRAFT		Application of singular perturbation theo	182-13106 Fy
Plight testing De Havilland Aircraft Limi DASH-8 utilizing onboard data analysis l			N82-12050
microprocessor	D Y	Computational methods of robust controlle for aerodynamic flutter suppression	er design
[AIAA PAPER 81-2507]	A82-13907	[NASA-CR-164983]	N82-12080
Two at a time - Flight test plans for the Boeing airliners	Dea	PHASE LOCKED SYSTEMS High speed microwave phase-locked loops	
[AIAA PAPSE 81-2378]	A82-13941		A82-14696
CT7 - GE attacks commuter turbopror market	t A82-15950	PHASE TRANSPORMATIONS 'In situ' composites for jet propulsion a	n d
Computer Air Carrier Symposium	102 13330	stationary gas turbine applications	ın u
[AD-A104894] PAVEMENTS	N82-12054	MULCED IDDIEG	A82-15824
Measured pavement response to transient as	ırcraft	PHASED ARRAYS Using phased array radar for data communi	cations
loadings			A82-14725
PERFORMANCE PREDICTION	N82-13442	Air-to-ground MII radar using a displaced center, phased array	pase
Performance estimation from non-steady man		•	A82-14881
[AIAA PAPER 81-2424] Comparison of wind tunnel and theoretical	A82-13863	PHOTCHAPPING Algorithms for an adaptive dynamic window	מו
aeroelastic predictions with flight mea:		electronic map systems	
airloads for the B-1 aircraft [AIAA PAPEB 81-2387]	A82-14393	Airborne Electronic Terrain Map System	A82-14769
Strapdown inertial reference systems perfe		rorrarn neb placem	A82-14771
analysis			

A82-14682

SUBJECT INDEX PROJECT MANAGEMENT

A VHF homing system with VBF radiotelephon area-representative strir-survey flights conducted, as part of combined forest		POLYIMIDE RESIDS Formulation and characterization of polyim resilient foams of various densities for	
inventories, with light aircraft carryinand 35 mm cameras	g 70 mm	aircraft seating applications [NASA-CR-167421]	N82-1223(
PILOT PERFORMANCE	A82-15748	POSITION ERRORS	
Have we overlooked the pilot's role in an		Updated station deselection procedures to automatic Omega receiver operation	
autcmated flight deck [AIAA 81-2262]	A82-13481	AN/TFN-25 and AN/GPN-22 precision approach	A82-14712 radars
Evaluation of a selected group of anti-exp garment configurations for their effects		POSTPLIGHT ABALTSIS	A82-14856
operational performance and survival of aircrewmen		Evaluating sources of error in EAR/GEANS navigation using a Kalman postprocessor	
PILOT TRAIBING 62% manned aircraft demonstrator - Next ge	A82-14972	Electronically Agile Radar/Gimbaled Elec suspended gyro Airborne Navigation Syste	
trainer cost effective pilot trainer		POTENTIAL PLON	
[AIAA PAPER 81-2519] USNTPS spin frogram	∆ 82-14385	Bemarks on the calculation of transonic po flow by a finite volume method	
	A82-14931		A82-15835
The USAF Test Pilot School high angle of a and spin training program	4tack 482-14932	POWER CCMDITIONING High voltage/high power for airborne appli	cations A82-1591
Acceptance testing of the Calspan variable		POWER EFFICIENCY	H02-15910
stability Learjet	A82-14937	Will power-by-ware replace power-by-hydrau	lics A82-1470
Computer image generation for flight simul		POWER SUPPLY CIRCUITS	
Simulator certification methods and the ve	182-15599 rtical	High woltage/high power for airborne appli	A82-1591
motion simulator		POWERED LIFT AIRCRAFT	
	N82-12082	Powered-lift takeoff performance character	
PIPER AIRCRAFT Flight test method for the determination o	e .	determined from flight test of the Quiet Short-haul Research Aircraft /QSRA/	
reciprocating engine cocling requirement		[AIAA FAPER 81-2409]	A82-13852
[AIAA PAPEE 81-2446]	A82-13878	PREDICTION ANALYSIS TECHNIQUES	102 1505
PISTON BRGINES An operational model of specific range for		Prediction of aerodynamic loads on aircraf external stores at transonic speeds	ts with
microprocessor applications in pistom-pr		catcalar stores at translate species	N82-1381
general aviation airplanes	_	PREMIXIEG	
[AIAA 81-2330]	A82-13526	Effect of fuel-air-ratio nonuniformity on	
Flight test method for the determination o reciprocating engine cocling requirement		emissions of nitrogen oxides [NASA-IF-1798]	N82-13143
[AIAA PAPEE 81-2446] PITCHING HOMENTS	∆82-13878	PRESSURE DISTRIBUTION Subcritical and supercritical airfoils for	
A calculation method for slender wing-body		pressure distribution	given
configurations in supersonic flow at hig		•	N82-1203
of attack nonlinear force and pitchi	ng	Pressure distributions on three different	
moment characteristics [BMVG-PBWT-79-15]	N82-13115	cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and	
PITOT TUBES		Volume 1: Trapezoidal tail	
Effects of intake geometry on circular pit intake performance at zero and low forwa		[NASA-TM-80097] PRESSURE DEOP	N82-1311
Intake periormance at zero and low forma	N82-13070	Experimental investigation of total pressu	re loss
PITTING		and airflow distribution for gas turbine	
Optimization of requirements on the pitting-prevention properties of turboje	t-engine	combustors	A82-1560
oils		PRESSORE EFFECTS	202 (200
	A82-15723	Effect of vacuum exhaust pressure on the	
PLANFORMS		performance of MHD ducts at high D-field	
Pressure distributions on three different cruciform aft-tail control surfaces of a		[NASA-TH-82750] PROCUREMENT MANAGEMENT	N82-1390
wingless missile at Mach 1.60, 2.36, and		Government testing	
Volume 1: Trapezoidal tail	3	[AIAA FAPBE 81-2443]	A82-1387
[NASA-TM-80097]	N82-13110	Flight test concept evolution	.02 430#
PLASMA SPRAYING Progress in protective coatings for aircra	ft gas	[AIAA PAPER 81-2375] PRODUCT DEVELOPMENT	A82-1394
turbines: A Review of BASA sponsored re		Advanced fighter technology integration AF	TI/P-16
[NASA-TM-82740]	N82-12216	test program overview	•
PLATINUM COMPOURDS		[AIAA PAPER 81-2353]	A82-1439
The protection of gas turbine blades - A p aluminide diffusion coating		Electromechanical actuation development pr	ogram A82-1470
PLEBUM CHAMBERS	A82-14364	PRODUCTION BEGINEERING Quality optimization and unification of av	1ation
Wind tunnel tests of powered models: A co of two methods of simulating the jets of		gasolines	A82-1572
engines	Jer	PROGRAM VEHIFICATION (COMPUTERS)	AUZ 13/2
,	N82-13087	The design and implementation of a canned	scenario
PHEUHATIC CONTROL		function for the P-16 dynamic system sim	ulator
A dual input actuator for fluidic tackup f	light		A82-1467
control	A82-13088	PROJECT BANAGEMENT Organizing and training for innovative fli	ght test
POLES (SUPPORTS)	a ė	management	100 4305
Computational methods of robust controller for aerodynamic flutter suppression	aesign	[AIAA PAPEE 81-2416] KC-10, flight test program management - Th	A82-1385
[NASA-CR-164983]	N82-12080	contractor's viewpoint	-
<u></u>		[AIAA PAPER 81-2380]	A82-1438

PROJECTILES SUBJECT INDEX

PROJECTILES Radar hostile fire location	RADAR BEACCHS Performance evaluation of target report extractor
PROPELLEE BLADES	in the monopulse ATCRBS Air Traffic Control Radar Beacon System
An analysis of civil aviation propeller-to-person accidents: 1965-1979 [AD-A105365]	A82-14776 A multimicroprocessor system for ATCRBS monopulse
PROPELLER EFFICIENCY	data processing A82-14777
An operational model of specific range for microprocessor applications in piston-prop	RADAR DATA Using phased array radar for data communications A82-14725
general aviation airplanes [AIAA 81-2330] A82-13526 PROPELIER PANS	Extended time radar raw wideo recording A82-14909
Prop-fan integration at cruise speeds	RADAR DETECTION Detection range analysis of an airborne medium PRF
PROPULSION SYSTEM CONFIGURATIONS	radar
The role and implementation of different nacelle/engine simulation concepts for	Radar hostile fire location
wind-tunnel testing in research and development work on transport aircraft	A82-14857 Noving target Detector/Airport Surveillance radar
N82-13086 NASA research in aircraft propulsion	(ASR-7) field evaluation [AD-A105196] N82-12303
[NASA-TM-82771] N82-13146 PROPULSION SYSTEM PERFORMANCE	BADAR EQUIPMENT Some Italian research for developing new primary
Advancing blade concept /ABC/ develorment test	ATC radars
Program [AIAA PAPEE 81-2437] A82-13873	BADAR FILTERS A82-14775
Recent propulsion system flight tests at the NASA Dryden Flight Besearch Center	Some Italian research for developing new primary ATC radars
[AĪAA PAPBĒ 81-2438] A82-13874 A look inside the Langley 16-foot transonic	RADAR IMAGERY
tunnel: User's guide [NASA-TM-83186] N82-12085	Inverse SAR and its application to aircraft classification
PROTECTIVE COATIEGS	A82-14871
The protection of gas turtine blades - A platinum aluminide diffusion coating	<pre>BADAR HAVIGATION Evaluating sources of error in EAR/GEANS</pre>
A82-14364 Progress in protective coatings for aircraft gas	<pre>navigation using a Kalman postprocessor Blectronically Agile Radar/Gimbaled Electrically</pre>
turbines: A Review of NASA sponsored research [NASA-TM-82740] N82-12216	suspended gyro Airborne Navigation System A82-14739
PULSE COMMUNICATION	BADAE BANGE
A modular multiplexed digital voice intercommunications system	Detection range analysis of an airborne medium PRF radar
PULSE DOPPLER RADAR	BADAR RECRIVERS
PULSE DOPPLER RADIR Detection range analysis of an airhorne medium PRF radar	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control
PULSE DOPPLER RADAR Detection range analysis of an airhorne medium PRF radar A82-14723 PULSED LASERS	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776
PULSE DOPPLER RADAR Detection range analysis of an airborne medium PRF radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 RADAR RESOLUTION P-15 SAR
PULSE DOPPLER RADAR Detection range analysis of an airhorne medium PRF radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLOHS Evaluation of an experimental technique to	BADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 RADAR RESOLUTION
PULSE DOPPLER RADIA Detection range analysis of an airhorne medium PRF radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLOES Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylcn/wing interference	Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 RADAR RESOLUTION F-15 SAR A82-14938 RADAR SCATTERING COMMERCIAL airborne weather radar technology A82-14868
PULSE DOPPLER RADAR Detection range analysis of an airhorne medium PRF radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLOHS Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylcn/wing interference N82-13090 Aerodynamic aspects of a high bypass ratio engine	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 RADAR RESOLUTION F-15 SAR A82-14938 RADAR SCATTERING COmmercial airborne weather radar technology
PULSE DOPPLER RADAR Detection range analysis of an airhorne medium PRF radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLONS Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylcn/wing interference A82-13090 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 RADAR RESOLUTION P-15 SAR A82-14938 RADAR SCATTERING Commercial airborne weather radar technology A82-14868 BADAR TARGETS Detection range analysis of an airborne medium PRF radar
PULSE DOPPLER RADAR Detection range analysis of an airhorne medium PRF radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLOHS Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylcn/wing interference N82-13090 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody PYROTECHNICS Emergency in-flight egress for general aviation	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 PADAR RESOLUTION P-15 SAR A82-14938 RADAR SCATTERING Commercial airborne weather radar technology A82-14868 BADAR TARGETS Detection range analysis of an airborne medium PRF radar Evaluation of advanced air-to-air gunnery fire control systems
PULSE DOPPLER RADAR Detection range analysis of an airhorne medium PRF radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLOBS Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylcn/wing interference N82-13090 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody N82-13093 PYROTBCHBICS Emergency in-flight egress for general aviation aircraft A82-14953	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 RADAR RESOLUTION F-15-SAR A82-14938 RADAR SCATTERING Commercial airborne weather radar technology A82-14868 BADAR TARGETS Detection range analysis of an airborne medium PRF radar A82-14723 Evaluation of advanced air-to-air gunnery fire control systems A82-14750 A new approach to radar plot extraction for ATC
PULSE DOPPLER RADAR Detection range analysis of an airhorne medium PRF radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLONS Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylcn/wing interference N82-13090 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody PYROTECHNICS Emergency in-flight egress for general aviation aircraft A82-14953 A ballustic design model for initiators for aircraft personnel escape systems	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 PADAR RESOLUTION P-15 SAR A82-14938 RADAR SCATTERING Commercial airborne weather radar technology A82-14868 RADAR TARGETS Detection range analysis of an airborne medium PRF radar Evaluation of advanced air-to-air gunnery fire control systems A82-14750 A new approach to radar plot extraction for ATC applications A82-14908
PULSE DOPPLER RADAR Detection range analysis of an airhorne medium PRF radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLONS Evaluation of an experimental technique to investigate the effects of the engine position on engine/rylcn/wing interference N82-13090 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody PYROTECHNICS Emergency in-flight egress for general aviation aircraft A82-14953 A ballustic design model for initiators for	PADAR RECRIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 RADAR RESOLUTION F-15-SAR A82-14938 RADAR SCATTERING Commercial airborne weather radar technology A82-14868 RADAR TARGETS Detection range analysis of an airborne medium PRF radar A82-14723 Evaluation of advanced air-to-air gunnery fire control systems A82-14750 A new approach to radar plot extraction for ATC applications RADAR TRACKING RADAR TRACKING RADAR TRACKING
PULSE DOPPLER RADAR Detection range analysis of an airhorne medium PRF radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLONS Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylcn/wing interference N82-13090 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody PYROTECHNICS Emergency in-flight egress for general aviation aircraft A82-14953 A ballustic design model for initiators for aircraft personnel escape systems	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 RADAR RESOLUTION F-15 SAR A82-14938 RADAR SCATTERING Commercial airborne weather radar technology A82-14868 RADAR TARGETS Detection range analysis of an airborne medium PRF radar Evaluation of advanced air-to-air gunnery fire control systems A82-14750 A new approach to radar plot extraction for ATC applications A82-14908 RADAR TRACKING RADAR TRACKING RADAR TRACKING RADAR TRACKING
PULSE DOPPLER RADAR Detection range analysis of an airhorne medium PRF radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLOUS Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylcn/wing interference A82-13090 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody PYROTECHNICS Emergency in-flight egress for general aviation aircraft A82-14953 A ballustic design model for initiators for aircraft personnel escape systems A82-14984	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 RADAR RESOLUTION F-15 SAR RADAR SCATTERING Commercial airborne weather radar technology A82-14868 BADAR TARGETS Detection range analysis of an airborne medium PRF radar Evaluation of advanced air-to-air gunnery fire control systems A82-14750 A new approach to radar plot extraction for ATC applications RADAR TRACKING Badar hostile fire location A82-14857 Air-to-ground MTI radar using a displaced phase center, phased array
PULSE DOPPLER RADAR Detection range analysis of an airhorne medium PRF radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLONS Evaluation of an experimental technique to investigate the effects of the engine position on engine/rylcn/wing interference N82-13090 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody N82-13093 PYROTECHNICS Emergency in-flight egress for general aviation aircraft A82-14953 A ballústic design model for initiators for aircraft personnel escape systems A82-14984 QUALITATIVE ANALYSIS Determination and analysis of jet and missile fuel deposits	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 PADAR RESOLUTION F-15 SAR A82-14938 RADAR SCATTERING Commercial airborne weather radar technology A82-14868 RADAR TARGETS Detection range analysis of an airborne medium PRF radar A82-14723 Evaluation of advanced air-to-air gunnery fire control systems A82-14750 A new approach to radar plot extraction for ATC applications A82-14908 RADAR TRACKING RADAR TRACKING Fadar hostile fire location A82-14857 Air-to-ground MTI radar using a displaced phase center, phased array A82-14881 A new approach to radar plot extraction for ATC
PULSE DOPPLER RADAR Detection range analysis of an airhorne medium PRF radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLOMS Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylcn/wing interference A82-13090 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody N82-13093 PYROTBCHNICS Emergency in-flight egress for general aviation aircraft A82-14953 A ballustic design model for initiators for aircraft personnel escape systems A82-14984 QUALITATIVE ANALYSIS Determination and analysis of jet and missile fuel deposits [AD-A105458] N82-12248 QUALITY CONTROL	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 RADAR RESOLUTION F-15-SAR RADAR SCATTERING Commercial airborne weather radar technology A82-14868 BADAR TARGETS Detection range analysis of an airborne medium PRF radar Evaluation of advanced air-to-air gunnery fire control systems A82-14750 A new approach to radar plot extraction for ATC applications RADAR TRACKING RADAR TRACKING BADAR TRACKING FADAR TRACKING Air-to-ground MTI radar using a displaced phase center, phased array A82-14881 A new approach to radar plot extraction for ATC applications A82-14881 A new approach to radar plot extraction for ATC applications A82-14908
PULSE DOPPLER RADIA Detection range analysis of an airhorne medium PRF radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLONS Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylcn/wing interference Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody PYROTECHNICS Emergency in-flight egress for general aviation aircraft A82-13093 PYROTECHNICS Emergency in-flight egress for general aviation aircraft A82-14953 A ballústic design model for initiators for aircraft personnel escape systems A82-14953 A82-14984 Q QUALITATIVE ANALYSIS Determination and analysis of jet and missile fuel deposits [AD-A105458] QUALITY CONTROL Quality optimization and unification of aviation gasolines	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 RADAR RESOLUTION F-15 SAR RADAR SCATTERING COmmercial airborne weather radar technology A82-14868 RADAR TARGETS Detection range analysis of an airborne medium PRF radar Evaluation of advanced air-to-air gunnery fire control systems A82-14750 A new approach to radar plot extraction for ATC applications RADAR TRACKING RADAR TRACKING RADAR TRACKING Air-to-ground MII radar using a displaced phase center, phased array A82-14881 A new approach to radar plot extraction for ATC applications RADARSCOPES A new approach to radar plot extraction for ATC
PULSE DOPPLER RADAR Detection range analysis of an airhorne medium PRF radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLONS Evaluation of an experimental technique to investigate the effects of the enqine position on engine/pylcn/wing interference A82-13090 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody N82-13093 PYROTECHNICS Emergency in-flight egress for general aviation aircraft A82-14953 A ballústic design model for initiators for aircraft personnel escape systems A82-14984 QUALITATIVE ANALYSIS Determination and analysis of jet and missile fuel deposits [AD-A105458] QUALITY CONTROL Quality optimization and unification of aviation	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 PADAR RESOLUTION F-15-SAR A82-14938 RADAR SCATTERING Commercial airborne weather radar technology A82-14868 RADAR TARGETS Detection range analysis of an airborne medium PRF radar Evaluation of advanced air-to-air gunnery fire control systems A82-14750 A new approach to radar plot extraction for ATC applications RADAR TRACKING Badar hostile fire location A82-14857 Air-to-ground BTI radar using a displaced phase center, phased array A82-14881 A new approach to radar plot extraction for ATC applications RADARSCOPES A new approach to radar plot extraction for ATC applications A82-14908 RADARSCOPES A new approach to radar plot extraction for ATC applications A82-14908
PULSE DOPPLER RADIA Detection range analysis of an airhorne medium P2F radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLOUS Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylcn/wing interference Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody PYROTECHNICS Emergency in-flight egress for general aviation aircraft A82-14953 A ballustic design model for initiators for aircraft personnel escape systems A82-14954 Q QUALITATIVE AHALYSIS Determination and analysis of jet and missile fuel deposits [AD-A105458] QUALITY CONTROL Quality optimization and unification of aviation gasolines A82-15721	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 RADAR RESOLUTION F-15 SAR RADAR SCATTERING Commercial airborne weather radar technology A82-14868 RADAR TARGETS Detection range analysis of an airborne medium PRF radar Evaluation of advanced air-to-air gunnery fire control systems A82-14723 A new approach to radar plot extraction for ATC applications RADAR TRACKING Badar hostile fire location Air-to-ground MTI radar using a displaced phase center, phased array A new approach to radar plot extraction for ATC applications RADARSCOPES A new approach to radar plot extraction for ATC applications RADARSCOPES A new approach to radar plot extraction for ATC applications
PULSE DOPPLER RADAR Detection range analysis of an airhorne medium P2F radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLOMS Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylcn/wing interference N82-13090 Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody N82-13093 PYROTECHNICS Emergency in-flight egress for general aviation aircraft A82-14953 A ballustic design model for initiators for aircraft personnel escape systems A82-14984 Q QUALITATIVE ANALYSIS Determination and analysis of jet and missile fuel deposits [AD-A105458] QUALITY CONTROL QUALITY CONTROL Quality optimization and unification of aviation gasolines R RADAR ANTERNAS	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 RADAR RESOLUTION F-15 SAR RADAR SCATTERING Commercial airborne weather radar technology A82-14868 BADAR TARGETS Detection range analysis of an airborne medium PRF radar Evaluation of advanced air-to-air gunnery fire control systems A82-14750 A new approach to radar plot extraction for ATC applications RADAR TRACKING Badar hostile fire location A82-14857 Air-to-ground MTI radar using a displaced phase center, phased array A82-14881 A new approach to radar plot extraction for ATC applications RADARSCOPES A new approach to radar plot extraction for ATC applications RADARSCOPES A new approach to radar plot extraction for ATC applications A82-14908 RADARSCOPES A new approach to radar plot extraction for ATC applications A82-14908 RADARSCOPES A new approach to radar plot extraction for ATC applications A82-14908 RADARSCOPES A new approach to radar plot extraction for ATC applications A82-14908 RADIATION DISTRIBUTION Collection and simulation of spatial infrared signatures of military jet aircraft
PULSE DOPPLEE RADIR Detection range analysis of an airhorne medium PEP radar A82-14723 PULSED LASERS ATARK laser tracking system A82-13016 PYLONS Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylcn/wing interference Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody PYROTECHNICS Emergency in-flight egress for general aviation aircraft A82-14953 A ballustic design model for initiators for aircraft personnel escape systems A82-14984 Q QUALITATIVE ANALYSIS Determination and analysis of jet and missile fuel deposits [AD-A105458] QUALITY CONTROL Quality optimization and unification of aviation gasolines A82-15721 R RADAR ANTERNAS Air-to-ground MTI radar using a displaced phase center, phased array	PADAR ESCRIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 PADAR ESSOLUTION P-15 SAR RADAR SCATTERING Commercial airborne weather radar technology A82-14868 BADAR TARGETS Detection range analysis of an airborne medium PEF radar Evaluation of advanced air-to-air gunnery fire control systems A82-14723 A new approach to radar plot extraction for ATC applications A82-14908 BADAR TRACKING Badar hostile fire location A82-14857 Air-to-ground MTI radar using a displaced phase center, phased array A new approach to radar plot extraction for ATC applications BADARSCOPES A new approach to radar plot extraction for ATC applications BADARSCOPES A new approach to radar plot extraction for ATC applications BADARSCOPES A new approach to radar plot extraction for ATC applications BADIATION DISTRIBUTION Collection and simulation of spatial infrared signatures of military jet aircraft [AIAA PAPER 81-2494] BADIO ALTIBUTERS
PULSE DOPPLEE RADIR Detection range analysis of an airhorne medium PEP radar A82-14723 PULSED LASERS ATARK laser tracking system BVLOUS Evaluation of an experimental technique to investigate the effects of the engine position on engine/pylcn/wing interference Aerodynamic aspects of a high bypass ratio engine installation on a fuselage afterbody PVROTECHBICS Emergency in-flight egress for general aviation aircraft A82-14953 A ballústic design model for initiators for aircraft personnel escape systems A82-14954 QUALITATIVE ANALYSIS Determination and analysis of jet and missile fuel deposits [AD-A105458] QUALITY COBTROL QUALITY COBTROL Quality optimization and unification of aviation gasolines A82-15721	PADAR RECEIVERS Performance evaluation of target report extractor in the monopulse ATCRBS Air Traffic Control Radar Beacon System A82-14776 PADAR RESOLUTION F-15 SAR RADAR SCATTERING Commercial airborne weather radar technology A82-14868 RADAR TARGETS Detection range analysis of an airborne medium PRF radar Evaluation of advanced air-to-air gunnery fire control systems A82-14723 A new approach to radar plot extraction for ATC applications RADAR TRACKING RADAR TRACKING RADAR TRACKING Air-to-ground MII radar using a displaced phase center, phased array A82-14881 A new approach to radar plot extraction for ATC applications RADARSCOPES A new approach to radar plot extraction for ATC applications RADARSCOPES A new approach to radar plot extraction for ATC applications A82-14908 RADIATION DISTRIBUTION Collection and simulation of spatial infrared signatures of military jet aircraft [AIAA PAPER 81-2494] A82-13921

SUBJECT IEDEX RESEARCH AIRCRAFT

The use of groundspeed, in a wind shear and flight evaluation of a radar-altimeter-bas system for the measurement of groundspeed		BEDUNDANCY Redundancy management of skewed and dispers inertial sensors	ed
[AD-A104758] N	182-12060	[AIAA 81-2296]	A82-13503
RADIO COMMUNICATION High-accuracy ranging over voice radios for		REFLECTANCE	_
aircrew rescue	downed	Prediction and performance of radome-covere reflector antennas	a
	82-14694		A82-15311
Distributed lime Division Multiple Access /D - A distributed signaling technique for ad		RBPUBLING KC-10 flight test program	
tactical communications			A82-14935
RADIO WAVIGATION	182-14719	BEGRESSION ANALYSIS On matching the systems identification tech	nique
Instrumentation to determine the suitability		to the particular application in eval	
RNAV systems for helicopter navigation in national airspace system /NAS/	the	flight test data	A82-13119
	82-13911	BELEASING	MOZ-13113
BADIO BANGE High-accuracy ranging over voice radios for	hornod	Automatic parachute releasers for premedita parachuting	ted
airdiem rescue	downed		A82-14960
RADIO RECEIVERS	182-14694	RELIABILITY ABALYSIS	
A Loran-C prototype navigation receiver for		Estimation of the efficiency of radioelectr flight navigation systems	onic
general aviation	00 40500	<u>-</u>	A82-13701
[AIAA 81-2329] New advances in signal processing technology	182-13532 for	Flanning a helicopter flight test program [AIAA PAPER 81-2381]	A82-13881
integrated CNI avionics Communication,		Bvaluation of a selected group of anti-expo	sure
Navigation, and Identification	182-14762	garment configurations for their effects operational performance and survival of N	
RADIO TRANSMISSION		aircrewmen	
Updated station deselection procedures to su automatic Gmega receiver operation	pport	Reliability analysis of the F-8 digital	A82-14972
A	82-14712	fly-by-wire system	
RADIOTELEPHONES A VHF homing system with VHF radiotelephony	for		N82-12079
area-representative strip-survey flights	101	BELIABILITY ENGINEERING An approach to robust nonlinear control des	ign
conducted, as part of combined forest	70	with illustration of J-85 turbojet engine	
<pre>inventories, with light aircraft carrying and 35 mm cameras</pre>	/U ##	simulation	A82-13128
	82-15748	F/A-18A weapon system - 1976 state of the a	
Prediction and performance of radome-covered	1	[AIAA 81-2215] The SIFT computer and its development S	A82-13453 oftware
reflector antennas		Implemented Fault Tolerance for aircraft	control
RANDON ACCESS	182-15311	[AIAA 81-2278] RRLIEP HAPS	A82-13490
Distributed Time Division Multiple Access /D		Airborne Electronic Terrain Map System	- 00 4:55
 A distributed signaling technique for ad tactical communications 	lvanced	Passive terrain following using stored map	A82-14771
. Δ	82-14719	global positioning system	
REACTION KINETICS Chemistry of combustion of fuel-water mixture	es:	REMOTE SENSING	A82-14772
[AD-A105401] N	182-12178	Computational considerations for fusion in	
REAL TIME OPERATION Avionics systems simulation for the Northrop	1	identification systems multisensor co	rrelation A82-14735
T/A-18L aircraft		REMOTELY PILOTED VEHICLES	
[AIAA 81-2274] Real-time flight management avionics softwar	182-13488	Flight experience with a remotely augmented wehicle flight test technique	
[AIAA 81-2340] A	82-13530	[AIAA PAPER 81-2417]	A 82-1385
Recent improvements at the Naval Air Test Ce	enter	HidaT aerodynamic design and flight test ex	perience 182-13871
for increased test system flexibility [AIAA PAPER 81-2392] A	82-13888	[AIAA PAPER 81-2433] The development and flight test evaluation	
The Advanced Range Instrumentation Aircraft		integrated propulsion control system for	the
improvement and modernization program [AIAA PAPEE 81-2368] A	82-13948	BIMAT research airplane [AIAA PAPER 81-2467]	A82-13931
Lockheed Airborne Cata System - Distributed	1	In-flight deflection measurement of the Hill	AT
nicrocomputers provide cn-board real-time [AIAA PAPER 81-2367]	anaiysis 182-13949	aeroelastically tailored wing [AIAA PAPER 81-2450]	A82-14381
General purpose real-time interaction panel	for	BESCUE OPERATIONS	
digital simulation of flight control s	systems 182-14831	<pre>Flight testing the suspended maneuvering sy helicopter firefighting and rescue te</pre>	
Group 1: Scenario design and development is	sues	[AIAA FAPER 81-2498]	A82-13922
N A real time Fegasus propulsion system model	182-13131 for	High-accuracy ranging over voice radios for aircrew rescue	downed
VSTOL piloted simulation evaluation			A82-14694
[NASA-TH-82770] RECEIVERS	182-13144	Rescue at sea	A82-14956
Design study report for General Aviation Lor	an-C	BESEARCH	143J(
receiver		A summary of the Naval Postgraduate School	
[AD-A104921] RECORDING INSTRUMENTS	182-12062	Besearch Program [AD-A104112]	N82-13975
Direct strike lightning measurement system -	for	RESEARCH AIRCRAFT	a+i
aircraft [AIAA PAPEE 81-2513] A	£2-13910	Powered-lift takeoff performance characters determined from flight test of the Quiet	stics
RECURSIVE FUNCTIONS		Short-haul Research Aircraft /QSRA/	100 43050
A recursive time demain analysis of distribution from the line grid networks with application to the		[AIAA PAPER 81-2409] Recent propulsion system flight tests at the	A82-13852 e NASA
LTA/EMP problem Lightning Threat Analy	sis	Dryden Plight Research Center	
À	182-14761	[AIAA PAPER 81-2438]	A82-13874

RESEARCH AND DEVELOPMENT SUBJECT INDEX

The development and flight test evaluation of an integrated propulsion control system for the HiMAT research airplane	ROTARY WINGS Advancing blade concept /ABC/ development test
[AIAA PAPER 81-2467] A82-13931	program [AIAA PAPER 81-2437] A82-13873
Powered-lift STOL aircraft shipboard operations -	A set of finite elements developed for the dynamic
A comparison of simulation, land-based and sea	computation of composite helicopter blades
trial results for the QSEA Quiet Short-haul	[ONERA, TP NO. 1981-87] A82-13990
Research Aircraft	Application of the ONERA dynamic stall model to a
[AIAA PAPEE 81-2480] A82-13938 New all-electric-system technology	helicopter blade in forward flight [ONERA, TP NO. 1981-89] A82-13992
electromechanical actuators for aircraft	Wind-tunnel investigation of the effects of blade
A82-14710	tip geometry on the interaction of torsional
Ball-Bartoe Jetwing flight tests	loads and performance for an articulated
A82-14928	helicopter rotor
RESEARCH AND DEVELOPMENT	[NASA-TP-1926] N82-13107
Aeronautics in China - An AIAA report Book A82-13150	ROTATING GENERATORS High speed PMG containment study for VSCF system
Civil aviation in China	Permanent Magnet Generator for Variable
A82-13600	Speed Constant Frequency applications
Advancing blade concept /ABC/ development test	A82-14791
program	ROTOR ABBODYNAMICS
[AIAA PAPER 81-2437] A82-13873 F/A-18 Flight Test program overview - 1 September	Rotor systems research aircraft /RSRA/ rotor force and moment measurement system
1981	[AIAA PAPER 81-2516] A82-13913
[AIAA PAPER 81-2351] A82-13955	Experimental and analytical studies of a model
Progress in aeronautical research and technology	helicopter rotor in hover
applicable to civil air transports	[NASA-TM-81232] N82-12042
A82-13974 Some Italian research for developing new primary	German-Argentine experiment: Vertical-rotor wind engine
ATC radars	N82-12648
A82-14775	Wind-tunnel investigation of the effects of blade
The payoff from U.S. investment in aeronautical	tip geometry on the interaction of torsional
research and development	loads and performance for an articulated
A82-14793 U.S. Navy life support development trends	helicopter rotor [NASA-TP-1926] N82-13107
A82-14952	An aerodynamic design and the overall stage
Current aerial cameras	performance of an air-cooled axial-flow turbine
A82-15655	[NAL-TR-321T] N82-13109
RESEARCH VEHICLES HIMAT aerodynamic design and flight test experience	ROTOR BLADES (TURBONACHINERY) Study of the load-carrying capacity of aviation
[AIAA PAPER 81-2433] A82-13871	qas-turbine engine impellers under low-cycle
RESONANT PREQUENCIES	loading at normal and high temperatures
Structural dynamics: Modified calculations	A82-15482
natural and harmonically excited vibrations of modified structures; increased computation	Thrust modulation methods for a subsonic V/STOL
	alrcraft [Nasa-TM-82747] N82-13112
efficiency [BMVG-FBWT-81-1] N82-13457	[NASA-TM-82747] N82-13112
efficiency [BMVG-FBWT-81-1] N82-13457 REYNOLDS NUMBER	
efficiency [BMVG-PBWT-81-1] N82-13457 REYNOLDS NUMBER Studies of air inlets at Feynolds numbers	[NASA-TH-82747] N82-13112 ROTOR SYSTEMS RESEARCH AIRCRAFT Rotor systems research aircraft /RSRA/ rotor force and moment measurement system
efficiency [BMVG-FBWT-81-1] N82-13457 REYNOLDS NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and S1MA wind	[NASA-TM-82747] N82-13112 ROTOR SYSTEMS RESEARCH AIRCRAFT Rotor systems research aircraft /RSRA/ rotor force and moment measurement system [AIAA PAPER 81-2516] A82-13913
efficiency [BMVG-FBWT-81-1] N82-13457 REYNOLDS NUMBER Studies of air inlets at Beynolds numbers comparable to flight in CNERA's F1 and S1MA wind tunnels	[NASA-TM-82747] N82-13112 ROTOR SYSTEMS RESEARCH AIRCRAFT Rotor systems research aircraft /RSRA/ rotor force and moment measurement system [AIAA PAPER 81-2516] A82-13913 ROTORCRAFT AIRCRAFT
efficiency [BMVG-FBWT-81-1] RETHOLDS NUMBER Studies of air inlets at Leynolds numbers comparable to flight in CNERA's F1 and S1MA wind tunnels N82-13091 Force and moment, flow-visualization, and	[NASA-TM-82747] N82-13112 ROTOR SYSTEMS RESEARCH AIRCRAFT Rotor systems research aircraft /RSRA/ rotor force and moment measurement system [AIAA PAPER 81-2516] A82-13913
efficiency [BMVG-FBWT-81-1] REYNOLDS NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and S1MA wind tunnels N82-13091 Force and moment, flow-visualization, and boundary-layer tests on a shuttle orbiter model	[NASA-TM-82747] N82-13112 ROTOR SYSTEBS RESEARCH AIRCRAFT Rotor systems research aircraft /RSRA/ rotor force and moment measurement system [AIAA PAPER 81-2516] A82-13913 ROTORCRAFT AIRCRAFT The use of frequency methods in rotorcraft system identification [AIAA PAPER 81-2386] A82-14392
efficiency [BMVG-FBWT-81-1] REYNOLDS NUMBER Studies of air inlets at Feynolds numbers comparable to flight in CNERA's F1 and S1MA wind tunnels N82-13091 Porce and moment, flcw-visualization, and boundary-layer tests on a shuttle orbiter model at Mach 6	[NASA-TM-82747] N82-13112 ROTOR SYSTEMS RESEARCH AIRCRAFT Rotor systems research aircraft /RSRA/ rotor force and moment measurement system [AIAA PAPER 81-2516] A82-13913 ROTORCRAFT AIRCRAFT The use of frequency methods in rotorcraft system identification [AIAA PAPER 81-2386] A82-14392 BOTORS
efficiency [BMVG-FBWT-81-1] REYNOLDS NUMBER Studies of air inlets at Feynolds numbers comparable to flight in CNERA's F1 and S1MA wind tunnels N82-13091 Porce and moment, flcw-visualization, and boundary-layer tests on a shuttle orbiter model at Mach 6 [NASA-TP-1952] N82-13106	[NASA-TH-82747] ROTOR SYSTEMS RESEARCH AIRCRAFT Rotor systems research aircraft /RSRA/ rotor force and moment measurement system [AIAA PAPER 81-2516] ROTORCRAFT AIRCRAFT The use of frequency methods in rotorcraft system identification [AIAA PAPER 81-2386] ROTORS High speed PMG containment study for VSCF system
efficiency [BMVG-FBWT-81-1] RETHOLDS NUMBER Studies of air inlets at Leynolds numbers comparable to flight in CNERA's F1 and S1MA wind tunnels N82-13091 Force and moment, flow-visualization, and boundary-layer tests on a shuttle orbiter model at Mach 6 [NASA-TP-1952] N82-13106 RICCATI EQUATION	[NASA-TM-82747] ROTOR SYSTEMS RESEARCH AIRCRAFT Rotor systems research aircraft /RSRA/ rotor force and moment measurement system [AIAA PAPER 81-2516] ROTORCRAFT AIRCRAFT The use of frequency methods in rotorcraft system identification [AIAA FAPER 81-2386] ROTORS BIGHA PAPER 81-2386] ROTORS High speed PMG containment study for VSCF system ——— Permanent Magnet Generator for Variable
efficiency [BMVG-FBWT-81-1] REYNOLDS WOMBER Studies of air inlets at Feynolds numbers comparable to flight in CNERA's F1 and S1MA wind tunnels N82-13091 Force and moment, flcw-visualization, and boundary-layer tests on a shuttle orbiter model at Mach 6 [NASA-TP-1952] RICCATI EQUATION Computational methods of robust controller design for aerodynamic flutter suppression	[NASA-TH-82747] ROTOR SYSTEMS RESEARCH AIRCRAFT Rotor systems research aircraft /RSRA/ rotor force and moment measurement system [AIAA PAPER 81-2516] ROTORCRAFT AIRCRAFT The use of frequency methods in rotorcraft system identification [AIAA PAPER 81-2386] ROTORS High speed PMG containment study for VSCF system
efficiency [BMVG-FBWT-81-1] REYNOLDS NUMBER Studies of air inlets at Feynolds numbers comparable to flight in CNERA's F1 and S1MA wind tunnels N82-13091 Force and moment, flcw-visualization, and boundary-layer tests on a shuttle orbiter model at Mach 6 [NASA-TP-1952] RICCATI EQUATION Computational methods of robust controller design for aerodynamic flutter suppression [NASA-CR-164983] N82-12080	[NASA-TM-82747] ROTOR SYSTEMS RESEARCH AIRCRAFT Rotor systems research aircraft /RSRA/ rotor force and moment measurement system [AIAA PAPER 81-2516] ROTORCAPT AIRCRAFT The use of frequency methods in rotorcraft system identification [AIAA PAPER 81-2386] ROTORS RIGH Speed PMG containment study for VSCF system Permanent Magnet Generator for Variable Speed Constant Frequency applications RODDERS
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efficiency [BMVG-FBWT-81-1] REVIOLDS NUMBER Studies of air inlets at Feynolds numbers comparable to flight in CNERA's F1 and SIMA wind tunnels N82-13091 Porce and moment, flcw-visualization, and boundary-layer tests on a shuttle orbiter model at Mach 6 [NASA-TP-1952] RICCATI EQUATION Computational methods of robust controller design for aerodynamic flutter suppression [NASA-CR-164983] RIGID MOTORS System identification helicopter parameters. Determination from flight tests, phase 2 [BMVG-FBWT-80-12] ROBUSTNESS (MATHEMATICS) An approach to robust nonlinear control design with illustration of J-£5 turbojet engine simulation ROLL P/A-1ê roll rate improvement program A82-13128 Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] ROLLING MOMENTS Effects of aerodynamic courling on the dynamics of roll aircraft ROTARY WING AIRCRAFT Development of a comprehensive analysis for	[NASA-TH-82747] ROTOR SYSTEMS RESEARCH AIRCRAFT Rotor systems research aircraft /RSRA/ rotor force and moment measurement system [AIAA PAPER 81-2516] ROTORCAFT AIRCRAFT The use of frequency methods in rotorcraft system identification [AIAA PAPER 81-2386] ROTORS High speed PMG containment study for VSCF system Permanent Magnet Generator for Variable Speed Constant Frequency applications RUDDERS Libited evaluation of an F-14A airplane utilizing an aileron-rudder interconnect control system in the landing configuration [NASA-TH-81972] RUNNAY CONDITIONS C-5A unsurfaced taxi and off-load demonstrations [AIAA PAPER 81-2439] Measured pavement response to transient aircraft loadings V82-13442 S SAFETY DEVICES *Little people* problem /MA-2 torso harness/ A82-14958 A new safety harness for mobile aircrew A82-14963 Test and evaluation of improved aircrew restraint systems
efficiency [BMVG-FBWT-81-1] REYNOLDS NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and SIMA wind tunnels N82-13091 Force and moment, flcw-visualization, and boundary-layer tests on a shuttle orbiter model at Mach 6 [NASA-TP-1952] RICCATI EQUATION Computational methods of robust controller design for aerodynamic flutter suppression [NASA-CR-164983] RIGID HOTORS System identification helicopter parameters. Determination from flight tests, phase 2 [BMVG-FBWT-80-12] ROBUSTNESS (MATHEMATICS) An approach to robust nonlinear control design with illustration of J-65 turbojet engine simulation A82-13128 ROLL F/A-16 roll rate improvement program Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] ROLLING MOMENTS Effects of aerodynamic coupling on the dynamics of roll aircraft ROTARY NING AIRCHAFT Development of a comprehensive analysis for rotorcraft. II - Aircraft model, solution procedure and applications A82-14407 A new safety harness for mobile aircrew	[NASA-TH-82747] ROTOR SYSTEMS RESEARCH AIRCRAFT Rotor systems research aircraft /RSRA/ rotor force and moment measurement system [AIAA PAPER 81-2516] ROTORCRAFT AIRCRAFT The use of frequency methods in rotorcraft system identification [AIAA FAPER 81-2386] ROTORS High speed PMG containment study for VSCF system Permanent Magnet Generator for Variable Speed Constant Frequency applications RUDDERS Libited evaluation of an F-14A airplane utilizing an aileron-rudder interconnect control system in the landing configuration [NASA-TH-81972] RUNDAY CONDITIONS C-5A unsurfaced taxi and off-load demonstrations [AIAA FAPER 81-2439] N82-13442 S SAFETY DEVICES *Little people* problem /MA-2 torso harness/ A82-14958 A new safety harness for mobile aircrew A82-14963 Test and evaluation of improved aircrew restraint systems A82-14974 Wind tunnel tests of ejection seat for high dynamic pressure escape A82-14979
efficiency [BMVG-FBWT-81-1] REYNOLDS WUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and SIMA wind tunnels N82-13091 Force and moment, flcw-visualization, and boundary-layer tests on a shuttle orbiter model at Mach 6 [NASA-TP-1952] RICCATI EQUATION Computational methods of robust controller design for aerodynamic flutter suppression [NASA-CR-164983] RIGID ROTORS System identification helicopter parameters. Determination from flight tests, phase 2 [BMVG-FBWT-80-12] ROBUSTNESS (MATHEMATICS) An approach to robust nonlinear control design with illustration of J-85 turbojet engine simulation A82-13128 ROLL F/A-18 roll rate improvement program A82-14939 Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] ROLLING MOMENTS Effects of aerodynamic coupling on the dynamics of roll aircraft ROTARY WING AIRCRAFT Development of a comprehensive analysis for rotorcraft. II - Aircraft model, solution procedure and applications	[NASA-TH-82747] ROTOR SYSTERS RESEARCH AIRCRAFT Rotor systems research aircraft /RSRA/ rotor force and moment measurement system [AIAA PAPER 81-2516] ROTORCRAFT AIRCRAFT The use of frequency methods in rotorcraft system identification [AIAA PAPER 81-2386] ROTORS High speed PMG containment study for VSCF system Permanent Magnet Generator for Variable Speed Constant Frequency applications RUDDERS Libited evaluation of an F-14A airplane utilizing an aileron-rudder interconnect control system in the landing configuration [NASA-TH-81972] RUNWAY CONDITIONS C-5A unsurfaced taxi and off-load demonstrations [AIAA PAPER 81-2439] Reasured pavement response to transient aircraft loadings SAPETY DEVICES Little people* problem /HA-2 torso harness/ A82-14958 A new safety harness for mobile aircrew A82-14963 Test and evaluation of improved aircrew restraint systems A82-14974 Wind tunnel tests of ejection seat for high dynamic pressure escape A82-14979 Practical aspects of instrumentation system
efficiency [BMVG-FBWT-81-1] REYNOLDS NUMBER Studies of air inlets at Reynolds numbers comparable to flight in CNERA's F1 and SIMA wind tunnels N82-13091 Force and moment, flcw-visualization, and boundary-layer tests on a shuttle orbiter model at Mach 6 [NASA-TP-1952] RICCATI EQUATION Computational methods of robust controller design for aerodynamic flutter suppression [NASA-CR-164983] RIGID HOTORS System identification helicopter parameters. Determination from flight tests, phase 2 [BMVG-FBWT-80-12] ROBUSTNESS (MATHEMATICS) An approach to robust nonlinear control design with illustration of J-65 turbojet engine simulation A82-13128 ROLL F/A-16 roll rate improvement program Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] ROLLING MOMENTS Effects of aerodynamic coupling on the dynamics of roll aircraft ROTARY NING AIRCHAFT Development of a comprehensive analysis for rotorcraft. II - Aircraft model, solution procedure and applications A82-14407 A new safety harness for mobile aircrew	[NASA-TH-82747] ROTOR SYSTEMS RESEARCH AIRCRAFT Rotor systems research aircraft /RSRA/ rotor force and moment measurement system [AIAA PAPER 81-2516] ROTORCRAFT AIRCRAFT The use of frequency methods in rotorcraft system identification [AIAA FAPER 81-2386] ROTORS High speed PMG containment study for VSCF system Permanent Magnet Generator for Variable Speed Constant Frequency applications RUDDERS Libited evaluation of an F-14A airplane utilizing an aileron-rudder interconnect control system in the landing configuration [NASA-TH-81972] RUNDAY CONDITIONS C-5A unsurfaced taxi and off-load demonstrations [AIAA FAPER 81-2439] N82-13442 S SAFETY DEVICES *Little people* problem /MA-2 torso harness/ A82-14958 A new safety harness for mobile aircrew A82-14963 Test and evaluation of improved aircrew restraint systems A82-14974 Wind tunnel tests of ejection seat for high dynamic pressure escape A82-14979

SUBJECT INDEX

SAFETY MANAGEMENT Patique methodology - A technical manageme	ent.	NAECCN 1981; Froceedings of the National Acan and Electronics Conference, Dayton, OB, E	
system for helicopter safety and durabil		19-21, 1981. Volumes 1, 2 & 3	A82-14676
SCALE EFFECT		Detection range analysis of an airborne med	
An investigation of F-16 nozzle-afterbody		radar	
at transonic Mach numbers with emphasis scale effects	on moder	New advances in signal processing technolog	A82-14723
[AD-A104905]	N82-12392	integrated CNI avionics Communication	
SCATTERING COEFFICIENTS		Navigation, and Identification	-•
Commercial airborne weather radar technolo		D	A82-14762
SCORING	A82-14868	Performance evaluation of target report ext in the monopulse ATCRBS Air Traffic (
Electro-optical vector scoring system	for	Radar Beacon System	COLCIOI
missile miss distance in fleet training	exercises	-	A82-14776
[AIAA PAPER 81-2373] SEA WATER	A82-13945	Radar hostile fire location	102 10057
Rescue at sea		F-15 SAR	A82-14857
	A82-14956	5 .5 555	A82-14938
SEARCH BADAR		SIGNAL RECEPTION	
Moving target Detector/Airport Surveilland (ASR-7) field evaluation	e radar	Opdated station deselection procedures to a automatic Omega receiver operation	support
[AD-A105196]	N82-12303	automatic omega receiver operation	A82-14712
SEATS		SIGNAL TO BOISE BATIOS	
Design of a crashworthy crew seat for the	Bceing	Digital signal processing on a background	
Vertol Chinook helicopter	A82-14975	rereflections for the international airculanting system	rart
Crashworthy military passenger seat develo		Iduding System	A82-13703
	A82-14976	SIKORSKY AIRCRAPT	
SERVICE LIPE	6	Light Mirborne Multi-Purpose System	100 10000
Operational evaluation of the new generati jet transport aircraft	.01 01	SIMULATICE	A82-13244
[AIAA PAPBE 81-2377]	A82-13942	Wind tunnel tests of powered models: A con	parison
Optimization of requirements on the		of two methods of simulating the jets of	jet
pitting-prevention properties of turboje oils	t-engine	engines	N82-13087
UIIS	A82-15723	SLENDER BODIES	H02-13007
SHIRLDING	_	A calculation method for slender wing-body	
Some RAE research on shielded and unshield fuselage mounted air intakes at subsonion		configurations in supersonic flow at high of attack nonlinear force and pitchin	
supersonic speeds	. 444	moment characteristics	19
	N82-13068	[BMVG-PBWT-79-15]	N82-13115
SHORT HAUL AIRCRAFT		SLENDER WINGS	
Powered-lift takeoff performance character determined from flight test of the Quiet		A calculation method for slender wing-body configurations in supersonic flow at high	h angles
Short-haul Research Aircraft /QSBA/		of attack nonlinear force and pitchin	
[AIAA PAPEE 81-2409]	A82-13852	noment characteristics	4344£
SHORT TAKEOFF AIRCRAFT Plight testing De Havilland Aircraft Limit	· ed	[BMVG-PBWT-79-15] SLOTTED WIND TUNNELS	N82-13115
DASH-8 utilizing onboard data analysis b		A look inside the Langley 16-foot transonic	3
microprocessor		tunnel: User's guide	
[AIAA PAPER 81-2507] Powered-lift STCL aircraft shipboard opera	A82-13907	[NASA-TM-83186] SOOT	N82-12085
A comparison of simulation, land-tased a		Chemistry of combustion of fuel-water mixtu	ıres
trial results for the CSBA Quiet Sho	rt-haul	[AD-A105401]	N82-12178
Research Aircraft	A82-13938	SOUND PROPAGATION	a taniala
[AIAA PAPER 81-2480] Ball-Bartoe Jetwing flight tests	NOZ- 13930	Impedance modeling of acoustic absorbing ma for aircraft engine applications	certais
	A82-14928		A82-14043
Integration of advanced exhaust nozzles	NOO 43075	SOURD WAVES	4.4
SHROUDED NOZZIES	N82-13075	Investigation of acoustic interactions in thrust augmenting ejectors	jet
The subsonic performance of practical mili	tary	[AD-A106083]	N82-13835
variable area convergent nozzles	NO2 43076	SPACE PLIGHT TRAINING	
SIDESLIP	N82-13076	Computer image generation for flight simula	16100 182-15599
A cost effective method for the control of	roll	SPACE SHUTTLE OBBITERS	
due to side slip on a low speed aircraft		Force and moment, flow-visualization, and	
[AIAA PAPER 81-2422] Effects of aerodynamic coupling on the dyn	A82-13861	boundary-layer tests on a shuttle orbited at Mach 6	e modes.
roll aircraft		[NASA-TP-1952]	N82-13106
	พ82-12070	Analysis of a longitudinal pilot-induced	
SIGNAL ABALYSIS An advanced facility for processing aircra	·f+	oscillation experienced on the approach a landing test of the space shuttle	ano
dynamic test data		[NASA-TM-81366]	N82-13149
[AIAA PAPEE 81-2398]	A82-14377	SPACE TRANSPORTATION SYSTEM PLIGHTS	_
SIGNAL DETECTION Digital detection and processing of laser	heacon	Selected stability and control derivatives	TION
signals for aircraft collision hazard wa		the first Space Shuttle entry [AIAA PAPER 81-2451]	A82-13880
[AIAA 81-2328]	A82-13525	SPACECRAFT CONTROL	_
SIGNAL PROCESSING Loint Tactical Microwave Landing System (ITHI C/	Selected stability and control derivatives	from
Joint Tactical Microwave Landing System /J airborne signal processing	1013/	the first Space Shuttle entry [AIAA PAPEB 81-2451]	A82-13880
[AIAA 81-2247]	A82-13471	SPACECRAFT DESIGN	
Digital signal processing on a background rereflections for the international airc		Research and Technology	N82-13043
landing system	t	[NASA-TM-83221]	202 13043

A82-13703

SPACECRAFT ELECTRONIC EQUIPMENT		STEPPING MOTORS
NAECON 1981; Proceedings of the National A		Failure analysis of variable reluctance stepper
and Electronics Conference, Dayton, OH, 19-21, 1981. Volumes 1, 2 & 3	мау	motor in electronic fuel control system on
13-21, 1901. VOI umes 1, 2 6 5	A82-14676	jet engine A82-14792
SPACECRAPT REBUTRY	202 11010	STORM DAMAGE
Selected stability and control derivatives	from	Operational evaluation of thunderstorm penetration
the first Space Shuttle entry		test flights during project Storm Hazards '80
[AIAA PAPEE 81-2451]	A82-13880	A82-14954
SPECTRAL SIGNATURES Collection and simulation of spatial infra	red	STRAIB GAGES Improved techniques for the calibration and
signatures of military jet aircraft		measurement of in-flight loads
[AIAA PAPER 81-2494]	A82-13921	[AIAA PAPER 81-2502] A82-13924
SPECTROSCOPIC ANALYSIS		STRAPDOWN IMBETIAL GUIDANCE
Determination and analysis of jet and miss	ile fuel	The use of separated multifunction inertial
deposits	¥ 02_ 12240	sensors for flight control
[AD-A105456] SPEECH RECOGNITION	N82-12248	[AIAA 81-2295] A82-13502 Redundancy management of skewed and dispersed
Using voice control onboard combat aircraft	t	inertial sensors
,	N82-13056	[AIAA 81-2296] A82-13503
SPEED CONTROL		Strapdown inertial reference systems performance
Plight investigations of integrated descen-	t rate	analysis
control systems	100 44000	A82-14682
COTH OPESC	A82-14929	STREAMLINED BODIES
SPIN TESTS USNTPS spin grogram		Turbulent wake development behind streamlined bodies N82-13104
Obiii bei e e e e e e e e e e e e e e e e	A82-14931	STRUCTURAL ANALYSIS
The USAF Test Pilot School high angle of a		Fatigue methodology - A technical management
and spin training program		system for helicopter safety and durability
	A82-14932	A82-13240
Navy spin evaluation of the A-7 airplane		Comparison of wind tunnel and theoretical
configured with automatic maneuvering fla		aeroelastic predictions with flight measured
F/A-18A high angle of attack/spin testing	A82-14933	airloads for the B-1 aircraft [AIAA FAPEE 81-2387] A82-14393
1/1 for 1132 unglo of decident light concing	A82-14934	Development of a comprehensive analysis for
SPLINES		rotorcraft. II - Aircraft model, solution
Flight testing the nonmetallic spline coup.	ling	procedure and applications
technology at the Naval Air Test Center		A82-14407
[AIAA PAPRE 81-2405]	A82-13891	STRUCTURAL DESIGN
SPOILERS Plight investigations of integrated descen	+ ra+o	Status and tracking system for flight test data
control systems	Liate	products [AIAA PAPER 81-2395] A82-14376
0021202 7/00025	A82-14929	Performance assessment of the ACES-II ejection
STABILITY DERIVATIVES		seat-A-10 configuration
Selected stability and control derivatives	from	A82-14980
the first Space Shuttle entry		Mathematical programming in engineering design
[AIAA PAPER 81-2451]	A82-13880	problems
Evaluation and wind tunnel tests of the 4, (normal-force) pitch/yaw and roll dynamic		A82-15864 STRUCTURAL RELIABILITY
stability balance systems for measuring		Design of a crashworthy crew seat for the Boeing
cross, and cross-coupling derivatives		Vertol Chincok helicopter
[AD-A105122]	N82-12047	A82-14975
Interactive aircraft flight control and		Crashworthy military passenger seat development
aeroelastic stabilization forward sw	ept wing	A82-14976
flight vehicles [NASA-CR-165036]	N82-13150	STRUCTURAL VIBRATION Flight vibration optimization via conformal mapping
STAGNATION FLOW	802 13130	A82-13975
Effects of intake geometry on circular pit-	ot	Analysis of a longitudinal pilot-induced
intake performance at zero and low forwa	rd speeds	oscillation experienced on the approach and
	N82-13070	landing test of the space shuttle
STAGNATION PRESSURE		[NASA-TM-81366] N82-13149
Pressure distributions on three different cruciform aft-tail centrel surfaces of a		Structural dynamics: Modified calculations natural and harmonically excited vibrations of
wingless missile at Mach 1.60, 2.36, and		modified structures; increased computation
Volume 1: Trapezcidal tail		efficiency
[NASA-TM-80097]	N82-13110	[BMVG-FBWT-81-1] N82-13457
STAMPING		SUBSONIC PLOW
The technology of sheet-metal stamping in		Calculation of wing-body-nacelle interference in
<pre>production of aircraft /2nd revised and edition/ Russian book</pre>	entarded	subsonic and transonic potential flow N82-13095
edition/ Massian book	A82-14998	Prediction of subsonic aircraft flows with jet
STANDARDIZATION	202 14330	exhaust interactions
Aircraft alerting systems standardization	study	N82-13096
[AIAA 81-2242]	A82-13468	SUBSOBIC SPEED
A standard control display unit for multi-	aircraft	Thrust modulation methods for a subsonic V/STOL
application	NOO 130E#	aircraft 「NASA-TH-827471 N82-13112
STATIC STABILITY	N82-13054	[NASA-TH-82747] N82-13112 SUBSOHIC MIND TUNNELS
The use of observers on relaxed static sta	bility	Studies of air inlets at Reynolds numbers
aircraft		comparable to flight in ONERA's F1 and S1MA wind
	A82-14740	tunnels
STATISTICAL ANALYSIS	• •	N82-13091
A criterion for determining the causes of	wind	SUPERCRITICAL FLOW
shear at Punta Raisi Airrort, on the bas statistical data from barograph records	TD 01	The influence of closed-coupled, rear fuselage mounted nacelles on the design of an advanced
	A82-15468	high speed wing

SUBJECT INDEX SYSTEMS INTEGRATION

SUPERCRITICAL WINGS	SYNTHETIC FORLS
Subcritical and supercritical airfoils for given	Development of catalytic systems for the
pressure distribution N82-12	conversion of syngas to jet fuel and diesel fuel and higher alcohols
The influence of closed-courled, rear fuselage	[DE82-000067] N82-12255
mounted nacelles on the design of an advanced	SYSTEM EFFECTIVENESS
high speed wing	Aircraft alerting systems standardization study
N82-130 SUPERSORIC AIRCRAFT	992 [AIAA 81-2242] A82-13468 Instrumentation to determine the suitability of
Aerodynamics of Power Plant Installation	ENAV systems for helicopter navigation in the
[AGARD-CP-301] N82-13	065 national airspace system /NAS/
Performance of highly integrated inlets for supersonic aircraft	[AIAA PAPER 81-2514] A82-13911
N82-13	Strapdown inertial reference systems performance 066 analysis
SUPERSONIC COMBUSTION	A82-14682
Effect of vacuum exhaust pressure on the	SYSTEM PAILURES
performance of MBD ducts at high D-field [NASA-TM-82750] N82-13	Direct digital design method for reconfigurable Bultivariable control laws for the A-7D Digitac
SUPERSORIC COMBUSTION BANJET ENGINES	II aircraft
Numerical analysis of the scramjet-inlet flow	A82-14828
field by using two-dimensional Navier-Stokes equations	Electronic master monitor and advisory display system test and demonstration report
[NASA-TP-1940] N82-13	
SUPERSORIC FLOW	Sensor failure detection system for the F100
A calculation method for slender wing-body	turbofan engine
configurations in supersonic flow at high angles of attack nonlinear force and pitching	S [NASA-CR-165515] N82-13145 SYSTEM IDENTIFICATION
moment characteristics	Integrated flight testing based on nonlinear
[BMVG-FBWT-79-15] N82-13	
SUPERSOHIC INLETS Performance of highly integrated inlets for	[AIAA PAPER 81-2449] A82-14389 The use of frequency methods in rotorcraft system
supersonic aircraft	identification
N82-13	066 [AIAA PAPER 81-2386] A82-14392
The design and development of the Tornado engine	Future directions in CNI integrated avionics
air intake N82-13	A82-14720 O74 SYSTEMS ENGINEERING
SUPERSONIC SPREDS	The design of exact nonlinear model followers
Pressure distributions on three different	with application to trajectory autopilot, for
cruciform aft-tail control surfaces of a wingless missile at Bach 1.60, 2.36, and 3.70.	belicopter A82-13125
Volume 1: Trapezoidal tail	Design and analysis of a digitally controlled
[NASA-TM-80097] N82-13	110 integrated flight/fire control system
SUPPORTS	[AIAA 81-2245] A82-13470
The load-carrying behavior of a trapezoidal aluminum-alloy supporting element, subjected to	LHX - An advanced avionics system design [AIAA 81-2249] A82-13472
a compressive stress, in the postbuckling region	
A82-14	
SURFACE FINISHING Attack on surgeralloys by chemical and electrolytic	[AIAA 87-2271] A82-13487 F/A-18 high authority/high gain digital flight
processes	control system development and flight testing
A82-14	
SURVEILLANCE RADAR Computational considerations for fusion in target	Experience with flight test trajectory guidance [AIAA PAPEE 81-2504] A82-14379
identification systems multisensor correlat.	
A82-14	735 and gust alleviation
SURVIVAL	[NASA-CR-3482] N82-13147 SYSTEMS INTEGRATION
HASEP - Survival from crashed Navy helicopters A82-14	
SURVIVAL EQUIPMENT	A82-1324
Evaluation of a selected group of anti-exposure	Integrated avionics - Concepts and concerns
garment configurations for their effects on the operational performance and survival of Naval	[AIAA 81-2211] A82-13452 Design and analysis of a digitally controlled
aircrewmen	integrated flight/fire control system
A82-14	
SWEPT FORWARD WINGS Divergence of a sweptforward wing	LHX - An advanced avionics system design [AIAA 81-2249] A82-1347
A82-13	
Interactive aircraft flight control and	Communication, Navigation, and Identification
aeroelastic stabilization forward swept win	
flight vehicles [NASA-CR-165036] N82-13	
SWITCHING CIRCUITS	sensory system /ISS/ for advanced aircraft
Electronic master monitor and advisory display	[AIAA 81-2297] A82-13504
system test and demonstration report [AD-A105317] N82-13	An integrated control panel utilizing a 141 programmable varistor-multiplexed dichroic
SYMMETRICAL BODIES	liquid crystal display
Turbulent wake development tehind streamlined tod	ies [AÏAA 81-2303] A82-1350
N82-13	•
SYNTHETIC APRETORE BADAR Enhanced P-15 arr-to-ground flight demonstrations	[AIAA 81-2317] A82-1351 Advanced weapon systems - Integration technology
[AIAA PAPEE 81-2413] A82-13	854 Digital Avionic Information System
Pave Mover Flight Test Program	[AIAA 81-2213] A82-1353
[AIAA PAPER 81-2492] A82-14 Inverse SAR and its application to aircraft	380 F-4 Advanced Avionics Plight Test [AIAA PAPER 81-2464] A82-1392
classification	The development and flight test evaluation of an
A82-14	871 integrated propulsion control system for the
F-15 SAB	HiMAT research airplane 938
	2.10 INIAN FAEGA G 17.24011 ADZ=1141

Integrated flight testing based on nonlinear system identification data processing techniques [AIAA PAPER 81-2449] A82-14389	TARGET ACQUISITICE The TADS/FNVS 'eyes' for the AB-64 attack helicopter A82-13239
Puture directions in CNI integrated avionics A82-14720	TARGET RECOGNITION
New advances in signal processing technology for	The TADS/FNVS 'eyes' for the AH-64 attack helicopter A82-13239
integrated CNI avionics Communication, Navigation, and Identification	Computational considerations for fusion in target identification systems multisensor correlation
A82-14762	A82-14735
Advanced integrated CNI architectures Communications, Navigation and Identification	The LANTIEN wide field-of-view raster Head-Up Display Low Altitude Navigation and
avionics for tactical aircraft and attack	Targeting IB for Night
helicopter A82-14763	A new approach to radar plot extraction for ATC
The agile transversal filter - A flexible building block for ICNIA Integrated Communications,	applications
Navigation and Identification Avionics	A82-14908 F-15 SAR
A82-14765 Conceptual design of an integrated power and	TARGET SINULATORS
avionics information system	A methodology for missile launch envelope display
A82-14788 A look inside the Langley 16-foot transonic	evaluation A82-14744
tunnel: User's guide	TECHNOLOGICAL FORECASTING
[NASA-TM-83186] N82-12085 Integration of advanced exhaust nozzles	The influence of smart computers on the cockpit of the future
N82-13075	A82-14743
Techniques for interfacing multiplex systems [AD-A101457] N82-13135	TECHHOLOGY ASSESSMENT Aeronautics in China - An AIAA report Book
SYSTEMS MANAGEMENT	A82-13150
Redundancy management of skewed and dispersed inertial sensors	Information technology and its impact on test and evaluation at the Naval Air Test Center
[AIAA 81-2296] A82-13503 SYSTEMS SIMULATION	[AIAA PAPER 81-2396] A82-13894 Progress in aeronautical research and technology
Avionics implications from weapon system	applicable to civil air transports
operational utility studies on Manned Air Combat Simulators	A methodology for missile launch envelope display
[AIAA 81-2230] A82-13463	evaluation
The design and implementation of a canned scenario function for the P-16 dynamic system simulator	A82-14744 Progress report - CH-47 modernization program
A82-14678 Strapdown inertial reference systems performance	A82-14930 F-15 SAR
analysis	A82-14938
A82-14682 A failure detection and isclation system for	The technology of sheet-metal stamping in the production of aircraft /2nd revised and enlarged
tactical aircraft with separated IMUs	edition/ Russian book
A82-14684 The use of observers on relaxed static stability	TECHNOLOGY UTILIZATION
aircraft A82-14740	Airborne Electronic Terrain Map System. II - Applications
Computer modeling of an aircraft HVDC electrical	A82-14773
system A82-14819	TRLEMBTRY Recent improvements at the Naval Air Test Center
Digital simulation of aircraft electrical qenerating system by means of Sceptre program	for increased test system flexibility [AIAA FAPER 81-2392] A82-13888
A82-14820	Automatic digital gain ranging for flight test
T	telemetry data [AIAA PAPER 81-2370] A82-13947
T-38 AIRCRAFT	The Advanced Range Instrumentation Aircraft improvement and modernization program
A ballistic design model for initiators for	[AIAA PAPER 81-2368] A82-13948
aircraft personnel escape systems A62-14984	MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design
TABS (CONTROL SURFACES) Trim tab excitation system for the BAe 146	[AD-A105393] N82-12061
A82-14363	TERMINAL CONFIGURED VEHICLE PROGRAM Have we overlooked the pilot's role in an
TACT PROGRAM Experience with flight test trajectory guidance	automated flight deck [AIAA 81-2262] A82-13481
[AIAA PAPEE 81-2504] A82-14379	The integration of control and display concepts
TAIL ASSEMBLIES Determining hinge moments and empennage airload	for improved pilot situational awareness A82-13972
parameters from flight data for Learjet airplanes A82-13120	TERMINAL PACILITIES
Pressure distributions on three different	Technical/operational ATC scenarios for future TMA navigation
cruciform aft-tail centrel surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70.	Analysis of integrated fuel-efficient, low-noise
Volume 1: Trapezoidal tail	procedures in terminal-area operations
[NASA-TH-8C097] N82-13110 TAKEOFF BUNS	[DE81-029833] N82-13014 TERRAIN ANALYSIS
The influence of wind shear and vertical winds on takeoffs and go-arounds	The electronic terrain map - A new avionics
A82-15823	integrator [AIAA 81-2289] A82-13498
TANKER AIRCRAFT KC-10, flight test program management - The	Application of multiple model estimation techniques to a recursive terrain height
contractor's viewscint	correlation system
[AIAA PAPER 81-2380] A82-14384 Tanker avionics and aircrew complement evaluation	A82-14768 Airborne Electronic Map Systems. I - Design
N82-13063	A82-14770 Alrborne Electronic Terrain Map System
	A82-14771

SUBJECT INDEX TORSIONAL VIBRATION

Airborne Electronic Terrain Map System. II	-	THREE DIMENSIONAL MOTION	
Applications	A82-14773	Experimental evaluation of a perspective tunders display for three-dimensional helicopter	nnel
TERRAIS FOLLOWING AIRCRAFT		approaches	
Passive terrain following using stored map global positioning system	and	THRUST	A82-15847
	A82-14772	Integration of advanced exhaust nozzles	
TEST EQUIPMENT			N82-13075
Recent improvements at the Maval Air Test C for increased test system flexibility	enter	Establishment of an experimental technique provide accurate measurement of the instal	
[AIAA PAPEE 81-2392]	A82-13888	drag of close coupled civil nacelle/airfr	ane
TEST FACILITIES Commentary on facilities used in the develo	rmont	configurations, using a full span model with turbine powered engine simulators	ı th
of a Sea Harrier all weather operations c	apabilıty		N82-13089
[AIAA PAPER 81-2407] The Air Porce Flight Test Center - Utah Tes	A82-13892	THRUST CONTROL Thrust modulation methods for a subsonic V/	t on a
Training Range in the 1980's	L and	alicraft	3101
	A82-13916	•	N82-13112
A unique integrated flight testing facility advanced control/display research	101	THRUST REVERSAL Advanced exhaust nozzle technology	
[AIAA PAPEE 81-2490]	A82-13919		N82-13078
Naval Weapons Center - Test and evaluation 1980's	in the	THRUST VECTOR CONTROL Effect of a part span variable inlet guide	wane on
[AIAA PAPER 81-2485]	A82-13940	TF34 fan performance	
Two at a time - Flight test plans for the n Boeing airliners	ew	[NASA-CR-165458] Advanced exhaust nozzle technology	N82-12075
[AIAA PAPER 81-2378]	A82-13941		N82-13078
Aeroelasticity matters - Some reflections o	n two	A real time Pegasus propulsion system model	for
decades of testing in the NASA Langley Tr Dynamics Tunnel	ansonic	VSTCL piloted simulation evaluation [NASA-TM-82770]	N82-13144
	A82-13969	THRUST-WEIGHT RATIO	
Testing capabilities of the 3246th Test Win [AIAA PAPER 81-2484]	g A82-14387	Enhanced F-15 air-to-ground flight demonstra [AIAA PAPER 81-2413]	ations A82-13854
TEST PILOTS		THUBDERSTORMS	
USMTPS spin grogram	A82-14931	Thunderstorm hazards flight research - Progr	cam
The USAF Test Pilot School high angle of at			A82-13853
and spin training program	A82-14932	Operational evaluation of thunderstorm pene-	
TEST BANGES	MOZ- 14932	test flights during project Storm Hazards	A82-14954
Naval Weapons Center - Test and evaluation	in the	TILT BOTOR AIRCRAFT	•
1980's [AIAA PAPER 81-2485]	A82-13940	Hover tests of the XV-15 Tilt Rotor Research Aircraft	n
TP-34 ENGINE		[AIAA PAPER 81-2501]	A82-14386
Effect of a part span variable inlet guide TP34 fan performance	wane on	TIMBER INVESTORY A VHF homing system with VHF radiotelephony	for
[NASA-CR-165458]	N82-12075	area-representative strip-survey flights	101
THERMAL PATIGUE Study of the load-carrying capacity of avia	tion	<pre>conducted, as part of combined forest inventories, with light aircraft carrying</pre>	70 mm
gas-turbine engine impellers under low-cy		and 35 mm cameras	, o mm
loading at normal and high temperatures	102 16402	TIME DIVISION MULTIPLE ACCESS	A82-15748
THERMAL PROTECTION	A82-15482	Distributed Time Division Multiple Access /	/AMDTO
Progress in protective coatings for aircraf		 A distributed signaling technique for a 	
turbines: A Review of NASA sponsored res	earch N82-12216	tactical communications	A82-14719
Research and Technology		TIME DIVISION MULTIPLEXING	
[NASA-TH-83221] THERMAL RESISTANCE	N82-13043	A modular multiplexed digital voice intercommunications system	
Formulation and characterization of polyimi	de		A82-14721
resilient fcams of various densities for aircraft seating applications		TIBE PUBCTIONS A recursive time domain analysis of distrib	n+od
	N82-12230	line grid networks with application to th	
THERMAL STABILITY A concept for a high-accuracy, low-cost		LTA/EMP problem Lightning Threat Anal	ysis A82-14761
accelerometer		TIME OPTIMAL CONTECL	802-14701
	A82-14685	Comparison between the exact and an approxi	
THESES Compilation of abstracts of dissertations t	heses.	feedback solution for medium range interc problems	effion
and research papers submitted by candidat	es for		A82-13106
degrees, 1 October 1979 - 30 September 19 [AD-A104124]	80 182-13974	TIME SHABING A polled contention multiplex system using	
THREE DIMENSIONAL PLOW		MIL-STD-1553 protocol	
Three dimensional flow investigation with a of characteristics in the inlet region an		[AIAA 81-2271]	A82-13487
blade-to-blade channels of supersonic axi		Determining binge moments and empennage air	
compressors [ESA-TT-637]	N82-12078	parameters from flight data for Learjet a	irplanes A82-13120
Prediction and measurement of time-variant,		TORSION	AUZ-13120
three-dimensional flows in military aircr		Wind-tunnel investigation of the effects of	
intakes	N82-13069	tip geometry on the interaction of torsion loads and performance for an articulated	nqt
A numerical method for studying		helicopter rotor	noo 4212-
nacelle-jet-airfcil interaction in invisc three-dimensional flow	1 d	[NASA-TP-1926] TORSIGHAL VIERATION	N82-13107
	N 82-13C94	Plight testing the nonmetallic spline coupl	ing
•		technology at the Baval Air Test Center [AIAA FAPEB 81-2405]	A82-13891
		furna faran a. m.a.)	

TRACKING BETWORKS SUBJECT INDEX

Georgia Tech coherent jammer flight test [AIAA PAPER 81-2452] Wing phased array radar for data communications, A82-14725 TRAINING AIRCRAFT 62% manned aircraft demonstrator - Next generation trainer cost effective pilot trainer [AIAA PAPER 81-2519] WSNTPS spin program A82-14385 USNTPS spin program A82-14931 The USAF Test Pilot School high angle of attack and spin training program A82-14932 TRAINING EVALUATION Organizing and training for innovative flight test management [AIAA PAPER 81-2416] Assessing pilot workload - Without disturbing pilot behavior A82-14745 TRAINING SIMULATORS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 Group 1: Scenario design and development issues A82-13534 Aeroelasticity matters - Some reflections on tradecades of testing in the NASA Langley Transc decades of testing in the NASA Langley transc dynamics tunnel [NASA-TH-83210] Construction and performance of NAL two-dimensional transonic wind tunnel [NASA-TH-83186] NASA-TH-83186] NASA-TH-83186	-13962 -13969 -13971 -13969 -12041 -12083 -12085 -13467
TRACKING RADAR Georgia Tech coherent jabber flight test [AIAA PAPER 81-2452] A82-13898 Using phased array radar for data communications. A82-14725 TRAINING AIECRAFT 62% manned aircraft demonstrator - Next generation trainer cost effective pilot trainer [AIAA PAPER 81-2219] A82-14385 USNTPS spin program A82-14931 The USAF Test Pilot School high angle of attack and spin training program A82-14932 TRAINING RVALUATION Organizing and training for innovative flight test management [AIAA PAPER 81-2416] A82-13856 Assessing pilot workload - Without disturbing pilot behavior A82-14745 TRAINING SIMULATORS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 Group 1: Scenario design and development issues N82-13331 A82-16725 A82-16725 A82-13318 A82-16725 A82-16725 A82-13318 A82-16725 A82-16725 A82-16725 A82-18785 A82-16725 A82-13731 A82-13731 A82-13731 A82-13731 A82-13738 A82-14725 A82-14725 The development of cryogenic wind tunnels and their application to maneuvering aircraft technology A82-14931 A82-1493	-13969 -13971 -13971 -12041 -12083 -12085 -13467 -29006 -13456
Using phased array radar for data comminications, A82-14725 TRAINING AIRCRAFT 62% manned aircraft demonstrator - Next generation trainer cost effective pilot trainer [AIAA PAPER 81-2519] The USATPS spin program A82-14931 The USAF Test Pilot School high angle of attack and spin training program Organizing and training for innovative flight test management [AIAA PAPER 81-2416] A82-13656 Assessing pilot workload - Without disturbing pilot behavior TRAINING SIMULATORS Low cost programmable multisimulator facility [AIAA 81-2229] Group 1: Scenario design and development issues Was-13331 decades of testing in the NASA Langley Transon Dynamics Tunnel A82-14725 The development of cryogenic wind tunnels and their application to maneuvering aircraft technology A82-14931 A82-14931 A82-14931 A82-14932 Construction and performance of NAL two-dimensional transonic wind tunnel [NASA-TH-83210] Construction and performance of NAL two-dimensional transonic wind tunnel [NASA-TH-83186] NASA-TH-83186] NASA-TH-83186] NASA-TH-83186] TRAINING SIMULATORS [AIAA 81-2239] TRAINING SIMULATORS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 Group 1: Scenario design and development issues NASC-131331	-13969 -13971 -13969 -13971 -12041 -12083 -12085 -13467 -13456 -13456
TRAINING AIRCRAFT 62% manned aircraft demonstrator - Next generation trainer cost effective pilot trainer [AIAA PAPER 81-2519] A82-14385 USNTPS spin program A82-14931 The USAF Test Pilot School high angle of attack and spin training program A82-14932 TRAINING EVALUATION Organizing and training for innovative flight test management [AIAA PAPER 81-2416] Assessing pilot workload - Without disturbing pilot behavior A82-14745 TRAINING SIMULATORS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 Group 1: Scenario design and development issues 882-13131 A82-13131 The development of cryogenic wind tunnels and their application to maneuvering aircraft technology A82-14935 Aeroelasticity matters: Some reflections on tidecades of testing in the NASA Langley transor dynamics tunnel [NASA-THA-83210] NAS2-14932 Construction and performance of NAL two-dimensional transonic wind tunnel [NASA-THA-83210] NAS2-14932 TRAINING SIMULATORS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 Group 1: Scenario design and development of cryogenic wind tunnels and their application to maneuvering aircraft technology Aeroelasticity matters: Some reflections on tidecades of testing in the NASA Langley transor dynamics tunnel [NASA-THA-83210] NAS2-14932 Construction and performance of NAL two-dimensional transonic wind tunnel [NAL-THA-647] A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-THA-83186] NAS2-14932 TRAINING SIMULATORS [AIAA 81-2239] TRAINING SIMULATORS [AIAA 81-2239] A82-13534 Aeroelasticity matters: Some reflections on tide changley transor dynamics tunnel [NAB-THA-83210] NAS2-14932 Construction and performance of NAL two-dimensional transonic vind tunnel [NAL-THA-647] A look inside the Langley 16-foot transonic [AIAA 81-2239] TRAINING SIMULATORS [AIAA 81-2239] TRAINING SIMULATORS [AIAA 81-2239] AB2-13534	-13971 -12041 -12083 -12085 -13467 -13456 -13456
TRAINING AIRCRAPT 62% manned aircraft demonstrator - Next generation trainer cost effective pilot trainer [AIAA PAPER 81-2519] A82-14385 USNTPS spin program A82-14931 The USAF Test Pilot School high angle of attack and spin training program A82-14932 TRAINING EVALUATION Organizing and training for innovative flight test management [AIAA PAPER 81-2416] Assessing pilot workload - Without disturbing pilot behavior TRAINING SIMULATORS Low cost programmable multisimulator facility [AIAA 81-2229] A82-14745 Group 1: Scenario design and development in cryogenic wind tunnels and their application to maneuvering aircraft technology technology A82-14931 A82-14932 A82-14932 A82-14932 Construction and performance of NAL two-dimensicnal transonic wind tunnel [NASA-TM-83210] NASA-TM-83210] NASA-TM-83186] NASA-TM-83210]	-13971 -12041 -12083 -12085 -13467 -13456 -13456
trainer cost effective pilot trainer [AIAA PAPER 81-2519] A82-14385 USNTPS spin program A82-14931 The USAF Test Pilot School high angle of attack and spin training program A82-14932 TRAINING EVALUATION Organizing and training for innovative flight test management [AIAA PAPER 81-2416] A82-13856 Assessing pilot workload - Without disturbing pilot behavior TRAINING SINULATORS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 Group 1: Scenario design and development issues We cost programmable multisimulator facility [AIAA 81-2218] A82-13131 TRAINING SINULATORS A82-14745 TRAINING SINULATORS A82-14745 TRAINING SINULATORS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 Group 1: Scenario design and development issues B82-13131 Technology Aeroelasticity matters: Some reflections on to decades of testing in the NASA Langley transor decades of testing	-12041 -12083 -12085 -13467 -13456 -13456
AB2-14931 The USAF Test Pilot School high angle of attack and spin training program A82-14932 TRAINING EVALUATION Organizing and training for innovative flight test management [AIAA PAPEE 81-2416] Assessing pilot workload - Without disturbing pilot behavior TRAINING SINULATORS Low cost programmable multisimulator facility [AIAA 81-2229] Group 1: Scenario design and development issues We construction and performance of NAL two-dimensional transonic wind tunnel [NAL-TB-647] A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TRAINING SINULATORS [AIAA 81-2239] AB2-13534 Group 1: Scenario design and development issues [AIAA 81-2218] AB2-13131	-12041 -12083 -12085 -13467 -13456 -13456
A82-14931 The USAF Test Pilot School high angle of attack and spin training program A82-14932 TRAINING EVALUATION Organizing and training for innovative flight test management [AIAA PAPEE 81-2416] Assessing pilot workload - Without disturbing pilot behavior TRAINING SINULATORS Low cost programmable multisimulator facility [AIAA 81-2229] Group 1: Scenario design and development issues A82-13131	-12041 -12083 -12085 -13467 -13456 -13483
A82-14932 TRAINING BVALUATION Organizing and training for innovative flight test management [AIAA PAPEE 81-2416] A82-13856 Assessing pilot workload - Without disturbing pilot behavior TRAINING SIMULATORS Low cost programmable multisimulator facility [AIAA 81-2229] Group 1: Scenario design and development issues N82-13131 [NASA-TM-83210] Construction and performance of NAL two-dimensional transonic wind tunnel (NAL-TB-647] A look inside the Langley 16-foot transonic tunnel: User's guide (NASA-TH-83186] N82-TRAINING: ARZ-TRAINING: ARZ-TRAIN	-12083 -12085 -13467 -13456 -13483
TRAINING EVALUATION Organizing and training for innovative flight test management [AIAA PAPEE 81-2416] Assessing pilot workload - Without disturbing pilot behavior TRAINING SINULATORS Low cost programmable multisimulator facility [AIAA 81-2229] Group 1: Scenario design and development issues N82-13131 A82-13131 Construction and performance of NAL two-dimensional transonic wind tunnel N82-TABLETIC (NAL-TR-647) A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TABLETIC (NASA-TH-83186) N82-TABLETIC (NAL-TR-647) A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TABLETIC (NAL-TR-647) A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TABLETIC (NAL-TR-647) A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TABLETIC (NAL-TR-647) A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TABLETIC (NAL-TR-647) A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TABLETIC (NAL-TR-647) A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TABLETIC (NAL-TR-647) A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TABLETIC (NAL-TR-647) A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TABLETIC (NAL-TR-647) A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TABLETIC (NAL-TR-647) A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TABLETIC (NAL-TR-647) A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TABLETIC (NAL-TR-647) A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TABLETIC (NAL-TR-647) A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TABLETIC (NAL-TR-647) A look inside the Langley 16-foot transonic tunnel: User's guide [NASA-TH-83186] N82-TABLETIC (NAL-T	-12083 -12085 -13467 -13456 -13483
Organizing and training for innovative flight test management [AIAA PAPER 81-2416]	-12085 -13467 eyond -13456 -13483
[AIAA PAPEE 81-2416] Assessing pilot workload - Without disturbing pilot behavior TRAINING SIMULATORS Low cost programmable multisimulator facility [AIAA 81-2229] Group 1: Scenario design and development issues N82-13131 A82-13131 A82-13186] TRAINING: User's guide (NASA-TH-83186] ARSPCHDES Aircraft separation assurance avionics [AIAA 81-2239] TRAINING AIRCRAFT Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and be also and also are also also and be also and also and also are als	-13467 eyond -13456 -13483
Assessing pilot workload - Without disturbing pilot behavior A82-14745 TRAINING SIMULATORS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 Group 1: Scenario design and development issues N82-13131 [NASA-TM-83186] AIRCRAFT Aprications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and be N82-13131	-13467 eyond -13456 -13483
TRAINING SINULATORS Low cost programmable multisimulator facility [AIAA 81-2229] A82-13534 Group 1: Scenario design and development issues N82-13131 A1rcraft separation assurance avionics [AIAA 81-2239] A82-13534 Applications of digital avionics to commercial transport aircraft - The DC-9 Super 80 and be N82-13131	eyond -13456 -13483
Low cost programmable multisimulator facility TRAESPORT AIRCRAFT APPLICATIONS of digital avionics to commercial APPLICATIONS OF TRAESPORT AIRCRAFT APPLICATIONS OF THE DC-9 Super 80 and be 182-13131 [AIAA 81-2218] A82-13131	eyond -13456 -13483
[AIAA 81-2229] A82-13534 Applications of digital avionics to commercial Group 1: Scenario design and development issues transport aircraft - The DC-9 Super 80 and be N82-13131 [AIAA 81-2218] A82-	-13456 -13483
N82-13131 [AIAA 81-2218] A82-	-13456 -13483
	-13483
warrent ein autri 611att best bestehtet entdere	
Experience with flight test trajectory guidance aircraft [AIAA PAPEE 81-2504] A82-14379 [AIAA 81-2264] A82-	·13506
The Maneuvering Flight Path Display - A flight Applications of head-up displays in commercial trajectory solution display concept transport aircraft	-13506
A82-14824 [AIAA 81-2300] A82-	
TRAJECTORY OPTIMIZATION On-board communication for active-control Darboux points in minimum-fuel aircraft landing transport aircraft	
problems [AIAA 81-2321] A82- A82-13077 Operational evaluation of the new generation of	13520
Puel efficient flight profiles in an ATC flow jet transport arcraft	
management environment [AIAA PAPER 81-2377] A82- A82-13078 Progress in aeronautical research and technology	-13942 17
On-line optimization of aircraft altitude and applicable to civil air transports flight path angle dynamics A82	-13974
A82-13107 An advanced facility for processing aircraft	133.4
Application of singular perturbation theory dynamic test data N82-12050 [AIAA PAPER 81-2398] A82-	-14377
TRANSCONTINENTAL SYSTEMS Wing design for light transport aircraft with Transportation systems evaluation methodology improved fuel economy	
development and applications, phase 3	-14416
[NASA-CR-164999] N82-12051 Enhanced aircraft handling qualities by the state of the	
Columbus, Ohio, Voice response system demonstration and evaluation In-service inspection methods for graphite-epo	-14826
[AD-A104750] N82-12304 structures on commercial transport aircraft	_
TRANSMISSION LINES [NASA-CR-165746] N82- Wire strike protection Electronic flight deck displays for military	-12142
A82-13246 transport aircraft	-13050
cable termination polisher Aerodynamics of Power Plant Installation	
[AD-A104797] N82-12448 [AGARD-CP-301] N82- TRANSHISSIONS (MACHINE RIBHENTS) Aerodynamic aspects of a high bypass ratio engi	-13065 ine
In-flight computation of helicopter transmission installation on a fuselage afterbody	-13093
[AIAA PAPER 81-2434] A82-13872 TRAPEZOIDAL TAIL SURFACES	- 12032
TRANSONIC FLOW Remarks on the calculation of transcnic potential Pressure distributions on three different cruciform aft-tail control surfaces of a	
flow by a finite volume method wingless missile at Mach 1.60, 2.36, and 3.70)_
A82-15835 Volume 1: Trapezoidal tail Transonic flows in an air inlet with large [NASA-TM-80097] N82-	-13110
incidence and the effect of a blowing trap N82-13071 Negro TRBNDS N82-13071 Advantages and limitations of various materials	a
Model testing techniques for measuring inlet drag used in the construction of modules arcs	
Calculation of wing-body-nacelle interference in [SNIAS-812-551-103] N82-	-12072
subsonic and transcric potential flow TURBINE BLADES N82-13095 The protection of gas turbine blades - A platic	פטב
Airframe-propulsion system aerodynamic aluminide diffusion coating	-14364
numbers including off-design engine airflow The operational characteristics of turbojets,	17304
effects giving particular attention to the cooled #82-13098 high-pressure turbine	
	-14414
N82-13813 turbines: A Review of NASA sponsored resear (NASA-TM-82740) N82-13813	

SUBJECT INDEX VISUAL CONTROL

Wind tunnel tests of powered models: A co	mraricon	• •	
of two methods of simulating the jets of		V	
engines	,	V/STOL AIECEAPT	
·	N82-13087	Commentary on facilities used in the develo	opment
TURBOCOMPRESSORS		of a Sea Harrier all weather operations of	
Three dimensional flow investigation with		[AIAA PAPEE 81-2407]	A82-13892
of characteristics in the inlet region a		Jet V/STCL wind-tunnel simulation and group effects	udbtape
<pre>blade-to-blade channels of supersonic ax compressors</pre>	191	effects	A82-13973
[ESA-TT-637]	N82-12078	The X-14 - 24 years of V/STOL flight testing	
TURBOFAN ENGINES	202 12070	100 1 11 10 100 01 1,0101 111910 00001	A82-14927
Performance assessment of an advanced rehe	ated	Thrust modulation methods for a subsonic V,	/STOL
turbo fan engine		aircraft	
[AIAA PAPER 81-2447]	A82-13879	[NASA-TH-82747]	N82-13112
The all composite Lear Fan 2100		A real time Pegasus propulsion system mode.	l for
0 C-13 1-11	A82-14936	VSTOL piloted simulation evaluation	200 1010
Sensor failure detection system for th turbofan engine	e 1100	[NASA-TM-82770] VACUUM EFFECTS	N82-13144
[NASA-CR-165515]	N82-13145	Effect of vacuum exhaust pressure on the	
TURBOJET ENGINE CONTECL	102 13143	performance of MHD ducts at high D-field	
An approach to robust ncnlinear control de	sian	[NASA-TM-82750]	N82-13908
with illustration of J-85 turbojet engin		VAPORS	
simulation		A vapour cycle cabin cooling system for the	e Sea
	A82-13128	King MK.50 belicopter	
Compressor stall inducing installation eff	ects of	[AD-A105211]	N82-12069
an engine control parameter for the CP-5		VARIABLE GEOMETRY STRUCTURES	
	N82-13085	The subscnic performance of practical mili-	tary
TURBOJET ENGINES		variable area convergent nozzles	N82-13076
The operational characteristics of turboje		VATOL AIRCRAFT	NO2-13070
giving particular attention to the coole high-pressure turbine	u.	Application of the concept of dynamic trim	control
might pressure cultime	A82-14414	and nonlinear system inverses to automat	
Optimization of requirements on the	202 11111	control of a vertical attitude takeoff a	
pitting-prevention properties of turboje	t-engine	landing aircraft	
oils		[AIAA 81-2238]	A82-13466
	A82-15723	VECTOR ANALYSIS	
"Vibration test procedures for accessory an		Electro-optical vector scoring system:	
drive gearboxes on Atar O9C engines	turbojet	missile miss distance in fleet training	
engines		[AIAA PAPER 81-2373]	A 82-13945
[AD-A105269]	N82-12076	VELOCITY MEASUREMENT	
TURBONACHIBRY		The use of groundspeed, in a wind shear an flight evaluation of a radar-altimeter-b	
The role and implementation of different nacelle/engine simulation concepts for		system for the measurement of groundspeed	
wind-tunnel testing in research and deve	lonment	[AD-A104758]	ัม82-12060
work on transport aircraft		VENTILATION	
	N82-13086	A vapour cycle cabin cooling system for the	e Sea
TURBOPROP EBGINES		King MK.50 belicopter	
CT7 - GB attacks commuter turboprop market	i	[AD-A105211]	N82-12069
**	A82-15950	VERTICAL DISTRIBUTION	
TURBULERT PLOS		German-Argentine experiment: Vertical-rot	or wind
The numerical solution of incompressible t	urbulent	engine	NOO 42600
flow over airfoils	NOO 12020	TERRICAL HOMION CINETINGODO	N82-12648
المراق Turbulent wake development behind streamli	N82-12030	VERTICAL MOTION SIMULATORS Simulator certification methods and the ve	rtical
Idingient Make descrobment rening streamin	N82-13104	motion simulator	reicur
TURBULENT WARES	102 13104	[NASA-CR-166252]	N82-12082
Turbulent wake development behind streamli	ned bodies	VIBRATICE DAMPING	
- · · · · · · · · · · · · · · · · · · ·	N82-13104	Wing/store flutter - An active adaptive co.	ntrol
		application	
- 11 -	-		A82-13122
U		Plight testing the nonmetallic spline coup	ling
UNLOADING		technology at the Naval Air Test Center	100 10001
C-5A unsurfaced taxi and off-load demonstr		[AIAA PAPER 81-2405]	A82-13891
[AIAA PAPEE 81-2439]	A82-13675	VIBRATICE TESTS Vibration test procedures for accessory an	alo
OBSTRADY PLOW An acquisition and analysis system for dyn	amic	drive gearboxes on Atar O9C engines	
tests of air inlets	duic	engines	carbojec
tests of all fulets	N82-13082	[AD-A105269]	N82-12076
UPPER SURPACE BLOWING	202 .5002	VIDEO DATA	
Ball-Bartoe Jetwing flight tests		Extended time radar raw video recording	
	A82-14928	•	A82-14909
USER REQUIREMENTS		VISCOUS PLOW	
Public service helicopters - Is the grass	greener	The numerical solution of incompressible t	urbulent
on the other side of the fence		flow over airfoils	
	A82-13238		N82-12030
Transportation systems evaluation methodol	.og y	VISIBILITY	
development and applications, phase 3	NO2-120E1	Use of a helmet-mounted matrix display for	
[NASA-CR-164999] UTILIZATION	N82-12051	presenting energy-maneuverability inform during simulated close combat	G C T O H
Advantages and limitations of Various mate	rials	duting simulated Close Compat	N82-13061
used in the construction of modules		VISUAL AIDS	
construction		Group 1: Scenario design and development	issues
[SNIAS-812-551-103]	H82-12072		N82-13131
-		VISUAL CCETEOL	
		The effect of visual information on manual	
		approach and landing	noo 1005:
		[NLB-MP-80019-0]	N82-12064

VISUAL PERCEPTION SUBJECT INDEX

VISUAL PERCEPTION Airborne color CRT displays	Airtorne Electronic Terrain Map System. II - Applications
A82-14823	A82-14773
VOICE COMMUNICATION High-accuracy ranging over voice radios for downed	WBATHBB Weather impact on low-altitude imaging infrared
aircrew rescue A82-14694	sensors in Europe - An availability model A82-14779
A modular multiplexed digital voice	WBATHBBING
intercommunications system	Practical aspects of instrumentation system
A82-14721 Columbus, Ohio, Voice response system	installation, volume 13 [NASA-TM-84067] N82-13140
demonstration and evaluation	WEIGHT INDICATORS
[AD-A104750] H82-12304	Evaluation and wind tunnel tests of the 4,000 lb
VOICE CONTROL Using voice control onboard combat aircraft	<pre>(normal-force) pitch/yaw and roll dynamic stability balance systems for measuring direct,</pre>
N82-13056	cross, and cross-coupling derivatives
VORTICES	[AD-A105122] N82-12047
Experimental and analytical studies of a model helicopter rotor in hover	WEIGHT BEDUCTION High voltage/high power for airborne applications
[NASA-TM-81232] N82-12042	A82-15918
	WIND EFFECTS
W	The influence of wind shear and vertical winds on takeoffs and go-arounds
WARNING SYSTEMS	A82-15823
Aircraft alerting systems standardization study	WIND SHEAR
[AIAA 81-2242] A82-13468	A decoupled control system for improved flight
Digital detection and processing of laser beacon signals for aircraft collision hazard warning	performance in wind shear A82-13079
[AIAA 81-2328] A82-13525	A criterion for determining the causes of wind
WAVE PROPAGATION	shear at Punta Raisi Airport, on the basis of
Updated station deselection procedures to support automatic Omega receiver operation	statistical data from barograph records A82-15468
A82-14712	The influence of wind shear and vertical winds on
WEAPON SYSTEM MANAGEMENT	takeoffs and go-arounds
Advanced wearon systems - Integration technology Digital Avionic Information System	A82-15823 The use of groundspeed, in a wind shear and the
[AIAA 81-2213] A82-13533	flight evaluation of a radar-altimeter-based
Government testing	system for the measurement of groundspeed
[AIAA PAPER 81-2443] A82-13877 Naval Weapons Center - Test and evaluation in the	[AD-A104758] N82-12060 WIND TUBBEL APPARATUS
1980's	Evaluation and wind tunnel tests of the 4,000 lb
[AIAA PAPES 81-2485] A82-13940	(normal-force) pitch/yaw and roll dynamic
WEAPON SYSTEMS Light Airborne Multi-Purpose System	stability balance systems for measuring direct, cross, and cross-coupling derivatives
A82-13244	[AD-A105122] N82-12047
Integrated avionics - Concepts and concerns	Construction and performance of NAL
[AIAA 81-2211] A82-13452 F/A-18A Weapon system - 1976 state of the art	two-dimensional transonic wind tunnel [NAL-TR-647] N82-12083
[AIAA 81-2215] A82-13453	A look inside the Langley 16-foot transonic
Avionics implications from wearon system operational utility studies on Manned Air Combat	tunnel: User's guide [NASA-TM-83186] N82-12085
Simulators	WIND TUNNEL CALIBRATION
[AIAA 81-2230] A82-13463	Construction and performance of NAL
LHX - An advanced avionics system design [AIAA 81-2249] A82-13472	two-dimensional transonic wind tunnel [NAL-TR-647] N82-12083
Higher order Information Transfer Systems are coming	WIND TOWNEL MODELS
[AIAA 81-2317] A82-13517	Aeroelasticity matters - Some reflections on two
Enhanced F-15 air-to-ground flight demonstrations [AIAA PAPER 81-2413] A82-13854	decades of testing in the NASA Langley Transonic Dynamics Tunnel
Theoretical analysis of wake-induced parachute	A82-13969
collapse [AIAA PAPER 81-1922] A82-13963	A review of flight-to-wind tunnel drag correlation
[AIAA PAPER 81-1922] A82-13963 Fighters - Improving the breed	[AIAA PAPER 81-2475] A82-14382 An investigation of F-16 nozzle-afterbody forces
A82-14354	at transonic Mach numbers with emphasis on model
Testing capabilities of the 3246th Test Wing [AIAA PAPER 81-2484] A82-14387	scale effects [AD-A104905] N82-12392
Assessing pilot workload - Without disturbing	[AD-A104905] N82-12392 Wind tunnel test and analysis techniques using
pilot behavior	powered simulators for civil nacelle
A82-14745 Evaluation of advanced air-to-air gunnery fire	ınstallatıcı drag assessment N82-13088
control systems	Establishment of an experimental technique to
A 82-1475G	provide accurate measurement of the installed
WEAPONS DELIVERY F-4 Advanced Avionics Flight Test	drag of close coupled civil nacelle/airframe configurations, using a full span model with
[AIAA PAPER 81-2464] A82-13929	turbine powered engine simulators
Development of a lifting parachute to provide	N82-13089
self-dispersing capability for an Avco-designed tactical munition	Pressure distributions on three different cruciform aft-tail control surfaces of a
[AIAA PAPEE 81-1928] A82-13962	wingless missile at Mach 1.60, 2.36, and 3.70.
Advanced fighter technology integration AFTI/F-16	Volume 1: Trapezoidal tail
test program overview [AIAA PAPER 81-2353] A82-14398	[NASA-TM-80(97] N82-13110 Thrust modulation methods for a subsonic V/STOL
Weapon delivery system using GPS	airciaft
A82-14711 Integrated Flight/Wearcn Control design and	[NASA-TH-82747] N82-13112 WIND TUNNEL STABILITY TESTS
evaluation	Direct free-flight analysis of aircraft dynamics
A 82-14741	at high angles of attack
	A82-15596

SUBJECT INDEX YAG LASERS

WIND TUBBEL TESTS	WING NACELLE CONFIGURATIONS
Navy performance mcdeling techniques	Establishment of an experimental technique to
[AIAA PAPEE 81-2431] A82-13869	provide accurate measurement of the installed
Overview of flight and ground testing with	drag of close coupled civil nacelle/airframe
emphasis on the wind tunnel	configurations, using a full span model with
[AIAA PAPER 81-2474] A82-13928	turbine powered engine simulators
A large-scale investigation of engine influence on inlet performance at angle-of-attack	N82-13089
[AIAA PAPER 81-2481] A82-13939	Evaluation of an experimental technique to investigate the effects of the engine position
Aeroelasticity matters - Some reflections on two	on engine/pylon/wing interference
decades of testing in the NASA Langley Transonic	n82-13090
Dynamics Tunnel	A numerical method for studying
A82-13969	nacelle-jet-airfoil interaction in inviscid
The development of cryogenic wind tunnels and	three-dimensional flow
their application to maneuvering aircraft	N82-13094
technology	WING OSCILLATIONS
A82-13971	Aeroelasticity matters: Some reflections on two
Jet V/STOL wind-tunnel simulation and groundplane	decades of testing in the NASA Langley transonic
effects	dynamics tunnel
A62-13973	[NASA-TH-83210] N82-12041
A review of flight-to-wind tunnel drag correlation	TING FOOTS
[AIAA PAPER 81-2475] A82-14382	AV-8B technical update - Leading edge root
Comparison of wind tunnel and theoretical aeroelastic preductions with flight measured	extension development A82-14940
airloads for the B-1 aircraft	WING-PUSELAGE STORES
[AIAA PAPER 81-2387] A82-14393	Wing/store flutter - An active adaptive control
Analysis of escape systems at 687 KEAS	application
A82-14978	A82-13122
Wind tunnel tests of ejection seat for high	WINGED VEHICLES
dynamic pressure escape	In-flight deflection measurement of the HiMAT
A82-14979	aeroelastically tailored wing
Aeroelasticity matters: Some reflections on two	[AIAA PAPRE 81-2450] A82-14381
decades of testing in the NASA Langley transonic	WINGS
dynamics tunnel	Calculation of wing-body-nacelle interference in
[NASA-TM-83210] N82-12041	subsonic and transonic potential flow
Construction and performance of NAL	N82-13095
two-dimensional transonic wind tunnel	Prediction of aerodynamic loads on aircrafts with
[NAL-TR-647] N82-12083	external stores at transonic speeds
Performance of highly integrated inlets for	N82-13813
supersonic aircraft N82-13066	Wine strake protection
Wind tunnel tests of powered models: A comparison	Wire strike protection A82-13246
of two methods of simulating the jets of jet	WORKING PLUIDS
engines	Efficient use of working fluids in aviation
N82-13087	hydraulic systems
Wind tunnel test and analysis techniques using	A82-15724
powered simulators for civil nacelle	HORKLOADS (PSYCHOPHYSIOLOGY)
installation drag assessment	Assessing pilot workload - Without disturbing
N82-13088	pılot behavior
Studies of air inlets at Beynolds numbers	A 82-14745
comparable to flight in CNERA's F1 and S1MA wind	
tunnels	X
N82-13091	^
The influence of closed-coupled, rear fuselage	w 46 1700010m
	T-14 AIRCRAFT The Y-14 - 24 years of W/STOL flight testing
mounted nacelles on the design of an advanced	The X-14 - 24 years of V/STOL flight testing
mounted nacelles on the design of an advanced high speed wing	The X-14 - 24 years of V/STOL flight testing A82-14927
mounted nacelles on the design of an advanced high speed wing N82-13092	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCRAFT
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade	The X-14 - 24 years of V/STOL flight testing A82-14927
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIBCBAFT Hover tests of the XV-15 Tilt Rotor Research Aircraft
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIBCRAFT Hover tests of the XV-15 Tilt Rotor Research
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCRAFT Hover tests of the XV-15 Tilt Botor Research Alrcraft [AIAA PAPER 81-2501] A82-14386
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter retor	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIBCBAFT Hover tests of the XV-15 Tilt Botor Research Aircraft
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCRAFT Hover tests of the XV-15 Tilt Botor Research Alrcraft [AIAA PAPER 81-2501] A82-14386
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70.	The X-14 - 24 years of V/STOL flight testing A82-14927 IV-15 AIRCRAFT HOVER tests of the IV-15 Tilt Rotor Research Alrcraft [AIAA PAPER 81-2501] A82-14386 Y IAG LASERS Options for GTE precision automated tracking system
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCBAFT Hover tests of the XV-15 Tilt Rotor Research Aircraft [AIAA PAPER 81-2501] A82-14386 Y YAG LASERS Options for GTE precision automated tracking system airborne laser tracking system
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TM-80097] N82-13110	The X-14 - 24 years of V/STOL flight testing A82-14927 IV-15 AIRCRAFT HOVER tests of the IV-15 Tilt Rotor Research Alrcraft [AIAA PAPER 81-2501] A82-14386 Y IAG LASERS Options for GTE precision automated tracking system
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TM-80097] N82-13110 Final report on the FueFo-4 major theme:	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCBAFT Hover tests of the XV-15 Tilt Rotor Research Alrcraft [AIAA PAPER 81-2501] A82-14386 Y YAG LASERS Options for GTE precision automated tracking system airborne laser tracking system
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TH-80097] Pinal report on the PueFo-4 major theme: Interference drag with airframe/engine	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCBAFT Hover tests of the XV-15 Tilt Rotor Research Alrcraft [AIAA PAPER 81-2501] A82-14386 Y YAG LASERS Options for GTE precision automated tracking system airborne laser tracking system
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TM-80097] Pinal report on the PueFo-4 major theme: Interference drag with airframe/engine integration on fighter aircraft	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCBAFT Hover tests of the XV-15 Tilt Rotor Research Aircraft [AIAA PAPER 81-2501] A82-14386 Y YAG LASERS Options for GTE precision automated tracking system airborne laser tracking system
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TM-80097] Pinal report on the PueFo-4 major theme: Interference drag with airframe/engine integration on fighter aircraft [BMVG-FBWT-79-20] N82-13116	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCBAFT Hover tests of the XV-15 Tilt Rotor Research Aircraft [AIAA PAPER 81-2501] A82-14386 Y YAG LASERS Options for GTE precision automated tracking system airborne laser tracking system
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TM-80097] Pinal report on the PueFo-4 major theme: Interference drag with airframe/engine integration on fighter aircraft [BMVG-PBMT-79-20] WINDOWS (APERTURES)	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCBAFT Hover tests of the XV-15 Tilt Rotor Research Aircraft [AIAA PAPER 81-2501] A82-14386 Y YAG LASERS Options for GTE precision automated tracking system airborne laser tracking system
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TH-80097] Pinal report on the PueFo-4 major theme: Interference drag with airframe/engine integration on fighter aircraft [BMCG-FBWT-79-20] WINDOWS (APERTURES) Algorithms for an adaptive dynamic window in	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCBAFT Hover tests of the XV-15 Tilt Rotor Research Aircraft [AIAA PAPER 81-2501] A82-14386 Y YAG LASERS Options for GTE precision automated tracking system airborne laser tracking system
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TM-80097] Pinal report on the PueFo-4 major theme: Interference drag with airframe/engine integration on fighter aircraft [BMVG-PBMT-79-20] WINDOWS (APERTURES)	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCBAFT Hover tests of the XV-15 Tilt Rotor Research Aircraft [AIAA PAPER 81-2501] A82-14386 Y YAG LASERS Options for GTE precision automated tracking system airborne laser tracking system
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TM-80097] Pinal report on the PueFo-4 major theme: Interference drag with airframe/engine integration on fighter aircraft [BMVG-PBWT-79-20] WINDOWS (APERTURES) Algorithms for an adaptive dynamic window in electronic map systems	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCBAFT Hover tests of the XV-15 Tilt Rotor Research Aircraft [AIAA PAPER 81-2501] A82-14386 Y YAG LASERS Options for GTE precision automated tracking system airborne laser tracking system
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TM-80097] Pinal report on the PueFo-4 major theme: Interference drag with airframe/engine integration on fighter aircraft [BMVG-FBWT-79-20] N82-13116 WINDOWS (APERTURES) Algorithms for an adaptive dynamic window in electronic map systems	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCBAFT Hover tests of the XV-15 Tilt Rotor Research Aircraft [AIAA PAPER 81-2501] A82-14386 Y YAG LASERS Options for GTE precision automated tracking system airborne laser tracking system
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TH-8097] Pinal report on the PueFo-4 major theme: Interference drag with airframe/engine integration on fighter aircraft [BMVG-PBWT-79-20] WINDOWS (APERTURES) Algorithms for an adaptive dynamic window in electronic map systems N82-14769	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCBAFT Hover tests of the XV-15 Tilt Rotor Research Aircraft [AIAA PAPER 81-2501] A82-14386 Y YAG LASERS Options for GTE precision automated tracking system airborne laser tracking system
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TH-80097] Final report on the FueFo-4 major theme: Interference drag with airframe/engine integration on fighter aircraft [BMVG-FBMT-79-20] WINDOWS (APERTURES) Algorithms for an adaptive dynamic window in electronic map systems A82-14769 WINDPOWERED GEMERATORS German-Argentine experiment: Vertical-rotor wind engine	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCBAFT Hover tests of the XV-15 Tilt Rotor Research Alrcraft [AIAA PAPER 81-2501] A82-14386 Y YAG LASERS Options for GTE precision automated tracking system airborne laser tracking system
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TH-80097] Pinal report on the PueFo-4 major theme: Interference drag with airframe/engine integration on fighter aircraft [BMVG-FBWT-79-20] WINDOWS (APERTURES) Algorithms for an adaptive dynamic window in electronic map systems A82-14769 WINDPOWERED GENERATORS German-Argentine experiment: Vertical-rotor wind engine N82-12648	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCBAFT Hover tests of the XV-15 Tilt Rotor Research Alrcraft [AIAA PAPER 81-2501] A82-14386 Y YAG LASERS Options for GTE precision automated tracking system airborne laser tracking system
mounted nacelles on the design of an advanced high speed wing N82-13092 Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rctor [NASA-TP-1926] Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TH-80097] Final report on the FueFo-4 major theme: Interference drag with airframe/engine integration on fighter aircraft [BMVG-FBMT-79-20] WINDOWS (APERTURES) Algorithms for an adaptive dynamic window in electronic map systems A82-14769 WINDPOWERED GEMERATORS German-Argentine experiment: Vertical-rotor wind engine	The X-14 - 24 years of V/STOL flight testing A82-14927 XV-15 AIRCBAFT Hover tests of the XV-15 Tilt Rotor Research Alrcraft [AIAA PAPER 81-2501] A82-14386 V YAG LASERS Options for GTE precision automated tracking system airborne laser tracking system

A82-14416

A82-13560

N82-12143

WING LOADING
Divergence of a sweptforward wing

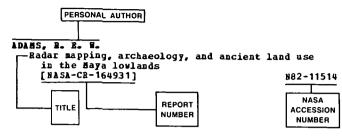
Effect of fighter attack spectrum on composite fatigue life
[AD-A105034] E82-

PERSONAL AUTHOR INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Suppl. 146)

MARCH 1982

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report) The accession number is located beneath and to the right of the title, e.g., N82-11514. Under any one author's name the accession numbers are arranged in sequence with the IAA accession numbers appearing first

ABELSON, P. W.
Costs of noise nuisance from aircraft A82-13314 Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 ACCARINO, N.
A new approach to radar plot extraction for ATC applications A82-14908 ACKERHANN, Robust flight control - A design example A82-15845 ADAM. B. C. F/A-18 'Hornet' - One man operability [AIAA 81-2266] A82-13484 F/A 18 Hornet crew station N82-13064 ADOLPH, C. B.
The Air Porce Plight Test Center - Utah Test and Training Range in the 1980's [AIAA PAPER 81-2487] A82-13916 AFREMOV, V. G. Current aerial cameras A82-15655 AGGARWAL, A. K.
Weapon delivery system using GPS A82-14711 AKHTER. M. M. Sensor failure detection system [NASA-CR-165515] N82-13145 ALBERT, V. B. Helicopter IFR - Past, present and future and future A82-13245 ALLEN. J. H. Weather impact on low-altitude imaging infrared sensors in Europe - An availability model A82-14779 ALTHAN, R. L.

Development and testing of dry chemicals in advanced extinguishing systems for jet engine

Effect of a part span variable inlet guide vane on

Pire extinguishant materials

[NASA-CASE-ARC-11252-1]

nacelle fires

ALVAREZ, J.

[NASA-CR-165011]

TP34 fan performance [NASA-CR-165458]

ANDERSON. L. R. Computational methods of robust controller design for aerodynamic flutter suppression N82-12080 [NASA-CR-164983] ANDERSSON, A. O. Aircraft absorbers - Promise and practice A82-14042 ANDREWS, H. W. Georgia Tech coherent jammer flight test
[AIAA PAPER 81-2452] A 82-13898 ABDREWS, W. H.
AD-1 oblique wing aircraft program [AIAA PAPER 81-2354] A82-14390 ARCHER, H. S., III The application of large screen CRT's, touch panels, and voice to the flight stations of the 199016 [AIAA 81-2263] A82-13482 ARDEMA, M. D.
Air-to-air combat analysis - Review of differential-gaming approaches A82-13115 ARETZ, A. J. Software considerations in the design of computer generated flight displays ASHER, B. J. Helicopter reliability and maintainability trends during development and production [AD-A105775] N82-13136 W. G. Advanced display systems for crew stations of tactical aircraft [AIAA 81-2312] 182-13514 ATTLEBLLUBR, S. System identification helicopter parameters.

Determination from flight tests, phase 2
[BMVG-FBWT-80-12] ATZHORN, D. Design and flight test of a lateral-directional command augmentation system [AIAA 81-2331] AYERS, T. G. A review of flight-to-wind tunnel drag correlation [AIAA PAPER 81-2475] A82-14382 BABB, C. D. Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and 3.70. Volume 1: Trapezoidal tail [NASA-TH-80097] N82-13110

BADALÌABCE, R. Effect of fighter attack spectrum on composite fatigue life [AD-A105034] N82-12143 BAER-RIEDHART, J. L. The development and flight test evaluation of an integrated propulsion control system for the HiMAT research airplane [AIAA PAPER 81-2467] A82-13931 BAHAWASSY, H.
Digital simulation of aircraft electrical generating system by means of Sceptre program Ã82-14820

Màthematical programming in engineering design problems A82-15864

BALASUBRAMANYAB, C.
Prediction of aerodynamic loads on aircrafts with external stores at transonic speeds N82-13813

N82-12168

BALIUK, A. D. Study of the load-carrying capacity of avagas-turbine engine impellers under low-cloading at normal and high temperatures		BRRUBE, R. A. Digital avionics - What a pilot expects to [AIAA 81-2217] BEVER, G. A.	see 182-13455
BALKE, H. Maneuver load control for the reduction of	182-15482	The development and use of a computer-inte- data acquisition and display system in a	ractive flight
loads and improvement of the maneuverabi modern fighter aircraft		environment [AIAA PAPER 81-2371] BEYER, R.	A82-13946
[BNVG-FBWT-81-2] BANG, C.	N82-13138	Experimental investigation of a helmet mou sight/display for helicopter	
Overview of flight and ground testing with	l .	DEWEND C	N82-13060
emphasis on the wind tunnel [AIAA PAPER 81-2474] BARAM, Y.	A82-13928	BEYERS, B. B. Direct free-flight analysis of aircraft dy at high angles of attack	namics
Fixed gain controller design for aircraft			A82-15596
[AD-A104877]	N82-12081	BIRK, K. A.	
BARBATO, G. J. Tanker avionics and aircrew complement eva	luation N82-13063	Improved techniques for the calibration an measurement of in-flight loads [AIAA PAPER 81-2502]	a A82-13924
BARTLETT, P. D., JR. Plight vibration optimization via conforma		BIBRENBACH, R. Wing design for light transport aircraft w	ıth
BASKETT, B. J. The TADS/PNVS 'eyes' for the AH-64 attack	182-13975	improved fuel economy BISSINGER, N. C.	A82-14416
BATSON, V. M.	182-13239	The design and development of the Tornado air intake	engine
A unique integrated flight testing facilit	y for		N82-13074
advanced control/display research	A82-13919	BLAKELOCK, J. H.	1 4
[AIAA PAPER 81-2490] BAXTER, D. ATARK laser tracking system	A02-13919	Design and analysis of a digitally control integrated flight/fire control system [AIAA 81-2245]	1ed 182-13470
	A82-13016	BOGACHEV, A. S.	
Study of the load-carrying capacity of avi gas-turbine engine impellers under low-c		Estimation of the efficiency of radioelect flight navigation systems	ronic A82-13701
loading at normal and high temperatures	,,010	BOGHANI, A. B.	A02 15701
BRAIRD, H. G., JR.	A82-15482	Experimental and analytical studies of adv air cushion landing systems	
The all composite Lear Fan 2100	A82-14936	[NASA-CR-3476] BOLT, R. F.	N82-12065
BEATTIE, E. C.	100 11300	A modular multiplexed digital voice	
Sensor failure detection system	200 43445	intercommunications system	
[NASA-CR-165515] BECLE, J. P.	N82-13145	BOREK, R. W.	A82-14721
Wind tunnel tests of powered models: A co of two methods of simulating the jets of		Practical aspects of instrumentation syste installation, volume 13	n n
engines	N82-13087	[NASA-TM-84067] BORGEBERSI, E.	N82-13140
BEDRIK, B. G. Efficient use of working fluids in aviation		A multimicroprocessor system for ATCRBS mo data processing	nopulse
hydraulic systems	100 1570#		A82-14777
BEHEIM, M. A.	A82-15724	BOTHA, D. G. Integrated avionics - Concepts and concern	~
NASA research in aircraft propulsion [NASA-TM-82771]	N82-13146	[AIAA 81-2211] The agile transversal filter - A flexible	A82-13452
BEHEL, I. M. F/A-18A high angle of attack/spin testing		block for ICNIA	A82-14765
	A82-14934	BOUCEK, G. P., JR.	
BEHNER, S. W. Implementing the CAIS executive	A82-14814	Aircraft alerting systems standardization [AIAA 81-2242] BOUSQUET, J.	study 182-13468
BENENT, L. J.	202 17014	A numerical method for studying	
Emergency in-flight egress for general aviaircraft		nacelle-jet-airfoil interaction in invis three-dimensional flow	
BERGER, E.	A82-14953	BOWER, R. E.	N82-13094
Comparison between the exact and an approx feedback sclution for medium range inter		Progress in aeronautical research and tech applicable to civil air transports	nology
problems	A82-13106	BOWERS, D. L.	A82-13974
BERNIUKOV, A. K. Digital signal processing on a background rereflections for the international airc		Integration of advanced exhaust nozzles BOID, R. W.	N82-13075
landing system		Naval Weapons Center - Test and evaluation	in the
BERRY, R. L.	A82-13703	1980's [AIAA PAPER 81-2485]	A82-13940
The LANTIEN wide field-of-view raster Head Display	•	BOYD, R. W. Navy performance modeling techniques	
BERSON, B. L.	A82-14825	[AIAA PAPER 81-2431] BOYDEN, R. P.	A82-13869
Aircraft alerting systems standardization [AIAA 81-2242]	study A82-13468	The development of cryogenic wind tunnels their application to maneuvering aircraf	
BERTOLONE, G.	3.0	technology	
Subsonic military aircraft engine intake: integrated theoretical experiment design		BOYLAN, N. G.	A82-13971
	พ82-13073	Index of National Aviation Facilities Expe	rimental
		Center technical reports 1972 - 1977 [AD-A104759]	N82-12056

PERSONAL AUTHOR INDEX

CHAO, Z.-F.

A82-15606

BRADER, R. H. Airborne Electronic Terrain Map System. II -High-accuracy ranging over voice radios for downed Applications aliciew rescue A82-14694 BURBS, R. C. BRADLEY, B. D. Strapdown inertial reference systems performance A new approach to modeling the cost of ownership for aircraft systems analysis [AD-A104434] BURTOB, E. A.
F/A-18 high authority/high gain digital flight NA2-13979 BRADSHAW, A. Design of direct digital flight-mode control control system development and flight testing [AIAA PAPER 81-2465] systems for high-performance aircraft A82-14829 BUTLER, R. W. Overview of flight and ground testing with emphasis on the wind tunnel [AIAA PAPER 81-2474] BRANDSTADT, R. J. Analytical and experimental characterization of the JAU-14/A cartridge actuated initiator for A82-13928 use in aircrew escape system performance BYRD, J. C. The LANTIBN wide field-of-view raster head-Up evaluation A82-14985 BRINDLE, J. A82-14825 Plat panel developments for future military aircraft
[AIAA 81-2302] A82-13507 BRITTON, J. W. Commentary on facilities used in the development CALAMIA, M. of a Sea Harrier all weather operations capability Some Italian research for developing new primary ATC radars [AIAA PAPER 81-2407] A82-13892 BROCK, L. D. A82-14775 CALISE, A. J.
On-line optimization of aircraft altitude and On-board communication for active-centrol transport aircraft [AIAA 81-2321] A82-13520 flight path angle dynamics Reliability analysis of the F-8 digital fly-by-wire system CALLOWAY, R. L. Force and moment, flow-visualization, and boundary-layer tests on a shuttle orbiter model [NASA-CR-163110] N82-12079 BROCKHURST, P. C.
High voltage/high power for airborne applications at Mach 6 A82-15918 [NASA-TP-1952] N82-13106 BROOKS, W. J. CAMANÀ, P. C. Acceptance testing of the Calspan variable Advanced integrated CNI architectures stability Learjet A82-14763 A82-14937 CAMPBELL, J. R. Investigation of acoustic interactions in jet BROWN R. A. W. thrust augmenting ejectors C-5A unsurfaced tax1 and off-load demonstrations [AIAA PAPER 81-2439] [AD-A106083] BROWN, T. W. CAMPBELL, R. P. Effects of intake geometry on circular pitot Design of a crashworthy crew seat for the Boeing intake performance at zero and low forward speeds Vertol Chinook helicopter A82-14975 CAPTAIN, K. H. BRUCKNER, J. M. B. Airplane performance sensitivities to lateral and vertical profiles Experimental and analytical studies of advanced air cushion landing systems [NASA-CR-3476] CARADONNA, F. X. BRUMBACK, B. D. Time-referencing of data in an asynchronous Experimental and analytical studies of a model helicopter rotor in hover [NASA-TM-81232] environment [AIAA 81-2341] A82-13531 N82-12042 BUCHANAN, T. D. CARLSON, B. A. Evaluation and wind tunnel tests of the 4,000 lb Evaluating sources of error in EAR/GEANS (normal-force) pitch/yaw and roll dynamic navigation using a Kalman postprocessor stability balance systems for measuring direct, A82-14739 cross, and cross-coupling derivatives [AD-A105122] CARPBETER, C. A.
Summary of Federal Aviation Administration N82-12047 BUCHHOLZ, W. responses to National Transportation Safety Board safety recommendations [AD-A104922] Applications of covariance analysis simulation to N82-12055 avionics flight testing A82-14767 CARTER, A. L. Comparison of wind tunnel and theoretical aeroelastic predictions with flight measured airloads for the B-1 aircraft Wind tunnel tests of ejection seat for high dynamic pressure escape A82-14979 [AIAA PAPER 81-2387] A82-14393 CARTER, E. C.
Wind tunnel test and amalysis techniques using BUNK. W. In situ' composites for jet propulsion and stationary gas turbine applications powered simulators for civil nacelle A82-15824 installation drag assessment BURCHAM, P. W., JR.

Recent propulsion system flight tests at the NASA

Dryden Plight Besearch Center N82-13088 CHAKRAVARTY, A. J. H.
Application of singular perturbation theory [AIAA PAPES 81-2438] N82-12050 BURKE, M. J. Application of a microprocessor controlled cockpit Modeling procedures for handling qualities display for enhanced pilot control of flight evaluation of flexible aircraft test maneuvers 182-13968 [AIAA PAPER 81-2510] A82-13908 CHANDRASHERAR, S.
A cost effective method for the control of roll BURKS, J. S. due to side slip on a low speed aircraft [AIAA PAPER 81-2422] Rotor systems research aircraft /RSRA/ rotor force and moment measurement system [AIAA PAPER 81-2516] A82-13913 CHAO, Z.-P. BURNHAM, G. Experimental investigation of total pressure loss Airborne Electronic Map Systems. I - Design . and airflow distribution for gas turbine

combustors

A82-14770

CHELINI, J. PRESCNAL AUTHOR INDEX

CHELINI, J. Real-time flight management avionics softw [AIAA 81-2340]	are system A82-13530	The all electric airplane - Its developmen logistic support	and A82-14709
CHOJHACKI, J.		CROSS, E. J., JR.	_
Raven aircraft filter-absorber [AD-A098962]	N82-13139	Flight test method for the determination of reciprocating engine cooling requirement	s
CHORLEY, R. A. Blectronic flight deck displays for transpaircraft	ort	[AIAA PAPER 81-2446] CRUCE, A. C. The need for and development of a samula	A82-13878
[AIAA 81-2264] Blectronic flight deck displays for milita	A82-13483	The need for, and development of, a simula facility at the Maval Air Test Center [ATAA PAPER 81-2488]	A82-13917
transport aircraft	N82-13050	CICOB, H. F., JB. A dual input actuator for fluidic backup f	
CHUN, R. K.	102 13030	control	Light
ARINC 429 digital data communications on t Boeing 757 and 767 commercial airliners			A82-13088
[AIAA 81-2267] CLARRICOATS, P. J. B.	A82-13485	D	
Prediction and performance of radome-cover reflector antennas	ed	DADONE, L. U. Helicopter icing	
Tellector dutennus	A82-15311	nelicopter icing	A82-13243
CLAY, C. W.		DALLE BESE, B.	
New all-electric-system technology	A82-14710	Performance evaluation of target report ex in the monopulse ATCRBS	
COCHRANE, J. A. Powered-lift takeoff performance character	istics	DANHEBERG, R.	A82-14776
determined from flight test of the Quiet		Experimental investigation of a helmet mou	inted
Short-haul Research Aircraft /QSRA/ [AIAA PAPER 81-2409]	A82-13852	sight/display for helicopter	N82-13060
COLBOURNE, D. E. Prediction and measurement of time-variant	.,	DASABO, J. A. Integration of controls and displays in US	Army
three-dimensional flows in military airc intakes	raft	helicopter cockpits	N82-13053
	N82-13069	DAVINO, D. S.	
COLLIES, H. M. A storage device for subsystem maintenance	•	LHX - An advanced avionics system design [AIAA 81-2249]	A82-13472
information	A82-14817	DAVIS, G. A.	
COLLIES, W. E.	A02-14017	Recent improvements at the Naval Air Test for increased test system flexibility	center
An analysis of civil aviation propeller-to	-person	[AIAA PAPER 81-2392]	A82-13888
accidents: 1965-1979 [AD-A105365]	N82-12053	Dazzo, J. Direct digital design method for reconfigu	
COLLIVER, D. J. Radar hostile fire location		multivariable control laws for the A-7D II aircraft	Digitac
COOK 1 I	A82-14857	DDAT D Y	A82-14828
<pre>COOK, J. L. KC-10, flight test program management - Th</pre>	ie	DEAL, P. L. Thunderstorm hazards flight research - Pro	ogram
contractor's viewpoint [AIAA PAPEE 81-2380]	A82-14384	OVERVIEW [AIAA PAPER 81-2412]	A82-13853
COOKE, D. R. Selected stability and control derivatives		Operational evaluation of thunderstorm pen test flights during project Storm Hazard	netration
the first Space Shuttle entry		- · · · ·	A82-14954
[AIAA PAPER 81-2451] CORRICK, G. E.	A82-13880	DEAN, L. B., III Impedance modeling of acoustic absorbing s	aterials
A methodology for missile launch envelope evaluation	display	for aircraft engine applications	A82-14043
	A82-14744	DRANDA, A. G.	
COSENTING, O. A criterion for determining the causes of	wind	AFFTC standard airspeed calibration proced [AD-A104830]	N82-12074
shear at Punta Raisı Aırport, on the bas		DEANGELIS, V. H.	
statistical data from barograph records	A82-15468	In-flight deflection measurement of the Hi aeroelastically tailored wing	.DAI
COSTER, J. R.	: .	[AIAA PAPER 81-2450]	A82-14381
Using voice control onboard combat aircraf	N82-13056	DELAHAYE, B. An acquisition and analysis system for dyn	amic
COULTER, S. H. Evaluation and wind tunnel tests of the 4,	.000 lb	tests of air inlets	N82-13082
(normal-force) pitch/yaw and roll dynami stability balance systems for measuring	.c	DEMIDENRO, K. A. Quality optimization and unification of a	
cross, and cross-coupling derivatives	-	gasolines	
[AD-A105122] COYLE, T. F.	N82-12047	DESIMONE, D. N.	A82-15721
Recent improvements at the Naval Air Test	Center	Escape systems decelerator technology	
for increased test system flexibility [AIAA PAPEE 81-2392]	A82-13888	[AIAA PAPER 81-1913] U.S. Eavy life support development trends	A82-13966
CRABILL, W. L. Thunderstorm hazards flight research - Pro	ogram	DHYANCHAND, J.	A82-14952
overview	_	Digital simulation of aircraft electrical	
[AIAA PAPER 81-2412] Operational evaluation of thunderstorm per	A82-13853 netration	generating system by means of Sceptre pr	rogram A82~14820
test flights during project Storm Hazard	ls ' 80	DIKE, G.	
CREEKHORE, R.	A82-14954	Inverse SAR and its application to aircramage classification	Ē t
A real time Pegasus propulsion system mode	el for	CIGGSIIICGCIUE	A82-14871
VSTOL piloted simulation evaluation		DILL, H. D.	
[NASA-TM-82770] CRONIN, M. J.	N82-13144	Effect of fighter attack spectrum on compo fatigue life	site
The role of avionics in the all electric a		[AD-A105034]	N82-12143
[AIAA 81-2219]	∆82-13457		

Crashworthy military passenger seat develop	pment A82-14976	ENDERLE, H. Comparison of different nozzle concepts for reheated turbofan	га
DOUGHERTY, B. P. High voltage/high power for airborne applic	cations	EMEVOLDSON, B. K.	N82-13077
DOUGLAS, L. L.	A82-15918	Flight test experience with high-alpha con- system techniques on the P-14 airplane	trol
Fatigue methodology - A technical management system for helicopter safety and durabil		[AIAA PAPER 81-2505] Experience with flight test trajectory qui	182-13906
Helicopter reliability and maintainability	A82-13240	[AIAA PAPER 81-2504] Limited evaluation of an F-14A airplane ut.	A82-14379
during development and production [AD-A105775]	N82-13136	an aileron-rudder interconnect control s the landing configuration	
DRESEL, D. L. The design and implementation of a canned.	scenario	[NASA-TM-81972] BHGLADD, J. N.	N82-13148
function for the F-16 dynamic system sim DRUMMOND, R. C.	ulator A82-14678	An advanced programmable/reconfigurable co- graphics display system for crew station technology research	lor
F/A-18A weapon system - 1976 state of the [AIAA 81-2215]	art A82-13453	[AIAA 81-2314] BNGLIN, B. A.	A82-13516
DUBRO, G. A. Assessment methodology of the lightning th advanced aircraft		Quality optimization and unification of avagasolines	iation A82-15721
	A82-14759	BULRICH, B. J.	B02-15721
DUDLEY, M. R. A large-scale investigation of engine infl	uence on	Modeling procedures for handling qualities evaluation of flexible aircraft	
inlet performance at angle-of-attack [AIAA PAPER 81-2481]	A82-13939	BWALD, B.	A82-13968
DURE, E. L. Experience with flight test trajectory gui		The role and implementation of different nacelle/engine simulation concepts for	•
[AIAA PAPER 81-2504] DUHE, G. L.	A82-14379	wind-tunnel testing in research and deve- work on transport aircraft	
Conceptual design of an integrated power a avionics information system			N82-13086
DUVAL, B. W.	A82-14788	F	
The use of frequency methods in rotorcraft identification	system	PAIR, D. Digital simulation of aircraft electrical	
[AIAA PAPER 81-2386] DYMENT, A.	A82-14392	generating system by means of Sceptre pr	ogram A82-14820
Transonic flows in an air inlet with large incidence and the effect of a blowing tr	ap N82-13071	FAIRPAX, B. K. Information technology and its impact on t evaluation at the Naval Air Test Center	est and
=		[AIAA PAPER 81-2396] PALCHERO, D.	A82-13894
E			-1
PRPDDIDNA D C		Application of the ONERA dynamic stall mod	er to a
EBERHARDT, R. G. Rescue at sea	A82-14956	helicopter blade in forward flight [ONERA, TP NO. 1981-89]	el to a 182-13992
Rescue at sea . EDGE, R. R.	A82-14956	helicopter blade in forward flight [ONEBA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressu	A82-13992 re loss
Rescue at sea	rared	helicopter blade in forward flight [ONEBA, TP NO. 1981-89] PAN, ZM.	A82-13992 re loss
Rescue at sea EDGE, R. R. Weather impact on low-altitude imaging inf isensors in Europe - An availability mode EDMONDSON, M. D.	rared 1 182-14779	helicopter blade in forward flight [ONERA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressuland airflow distribution for gas turbine combustors PARLEY, E. L.	A82-13992 re loss A82-15606
Rescue at sea RDGE, R. R. Weather impact on low-altitude imaging inf Sensors in Europe - An availability mode	rared 1 A82-14779 ttack	helicopter blade in forward flight [ONEBA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressuand airflow distribution for gas turbine combustors PARLEY, H. L. Experimental and analytical studies of advair cushion landing systems	A82-13992 re loss A82-15606 anced
Rescue at sea BDGB, R. R. Weather impact on low-altitude imaging inf isensors in Europe - An availability mode EDMONDSON, M. D. The USAF Test Pilot School high angle of a and spin training program EDWARDS, D. H.	rared 1 1	helicopter blade in forward flight [ONERA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressuland airflow distribution for gas turbine combustors FARLEY, H. L. Experimental and analytical studies of advair cushion landing systems [NASA-CR-3476] FARHER, E. H.	A82-13992 re loss A82-15606 anced N82-12065
Rescue at sea EDGB, R. R. Weather impact on low-altitude imaging inf isensors in Europe - An availability mode EDHONDSON, M. D. The USAF Test Pilot School high angle of a and spin training program EDWARDS, D. H. Vibration test procedures for accessory an drive gearboxes on Atar 09C engines [AD-A105269]	rared 1 1	helicopter blade in forward flight [ONEBA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressuand airflow distribution for gas turbine combustors FARLEY, H. L. Experimental and analytical studies of advair cushion landing systems [NASA-CR-3476] FARMER, B. H. Real-time flight management avionics softworks	A82-13992 re loss A82-15606 anced N82-12065 are system A82-13530 ircraft
Rescue at sea EDGB, E. R. Weather impact on low-altitude imaging inf sensors in Europe - An availability mode EDMONDSON, M. D. The USAF Test Pilot School high angle of a and spin training program EDWARDS, D. H. Vibration test procedures for accessory an drive gearboxes on Atar 09C engines [AD-A105269] EIDELHAN, D. Fixed gain controller design for aircraft	rared 1 A82-14779 ttack A82-14932 gle N82-12076	helicopter blade in forward flight [ONERA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressuand airflow distribution for gas turbine combustors PARLEY, H. L. Experimental and analytical studies of advair cushion landing systems [NASA-CR-3476] PARMER, B. H. Real-time flight management avionics software [AIAA 81-2340] Flight management systems for modern jet and PARQUHAR, B. W.	A82-13992 re loss A82-15606 anced N82-12065 are system A82-13530 ircraft A82-14778
Rescue at sea **BDGB, R. R. Weather impact on low-altitude imaging inf	rared 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	helicopter blade in forward flight [ONEBA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressuand airflow distribution for gas turbine combustors FARLEY, B. L. Experimental and analytical studies of advair cushion landing systems [NASA-CR-3476] FARMER, B. H. Real-time flight management avionics softw. [AIAA 81-2340] Flight management systems for modern jet a FARQUHAR, B. W. A large-scale investigation of engine inflinlet performance at angle-of-attack	A82-13992 re loss A82-15606 anced N82-12065 are system A82-13530 ircraft A82-14778 uence on
Rescue at sea EDGR, R. R. Weather impact on low-altitude imaging inf isensors in Europe - An availability mode EDMONDSON, M. D. The USAF Test Pilot School high angle of a and spin training program EDWARDS, D. H. Vibration test procedures for accessory an drive gearboxes on Atar 09C engines [AD-A105269] EIDELMAND. Fixed gain controller design for aircraft [AD-A104877]	rared 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	helicopter blade in forward flight [ONERA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressuand airflow distribution for gas turbine combustors FARLEY, H. L. Experimental and analytical studies of advair cushion landing systems [NASA-CR-3476] FARMER, B. H. Real-time flight management avionics softw. [AIAA 81-2340] Flight management systems for modern jet a FARQUHAR, B. W. A large-scale investigation of engine inflinlet performance at angle-of-attack [AIAA PAPER 81-2481]	A82-13992 re loss A82-15606 anced N82-12065 are system A82-13530 ircraft A82-14778
Rescue at sea **BDGB, R. R. Weather impact on low-altitude imaging inf	rared 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	helicopter blade in forward flight [ONEBA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressuand airflow distribution for gas turbine combustors FARLEY, B. L. Experimental and analytical studies of advair cushion landing systems [NASA-CR-3476] FARMER, B. H. Real-time flight management avionics softw. [AIAA 81-2340] Flight management systems for modern jet a FARQUHAR, B. W. A large-scale investigation of engine inflinlet performance at angle-of-attack	A82-13992 re loss A82-15606 anced N82-12065 are system A82-13530 ircraft A82-14778 uence on
Rescue at sea BDGB, R. R. Weather impact on low-altitude imaging inf sensors in Europe - An availability mode EDMONDSOW, M. D. The USAF Test Pilot School high angle of a and spin training program EDWARDS, D. H. Vibration test procedures for accessory an drive gearboxes on Atar 09C engines [AD-A105269] EIDELMAN, D. Fixed gain controller design for aircraft [AD-A104877] ELDER, R. J. Assessing pilot workload - Without disturb pilot behavior ELLEBBE, R. Design study report for General Aviation L.	rared 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	helicopter blade in forward flight [ONERA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressuland airflow distribution for gas turbine combustors PARLEY, H. L. Experimental and analytical studies of advair cushion landing systems [NASA-CR-3476] PARMER, B. H. Real-time flight management avionics softw. [AIAA 81-2340] Flight management systems for modern jet a PARQUHAR, B. W. A large-scale investigation of engine inflinlet performance at angle-of-attack [AIAA PAPER 81-2481] FARRELL, B. J. Index of National Aviation Facilities Experenter technical reports 1972 - 1977 [AD-A104759]	A82-13992 re loss A82-15606 anced N82-12065 are system A82-13530 ircraft A82-14778 uence on
Rescue at sea **BDGB, R. R. Weather impact on low-altitude imaging inf sensors in Europe - An availability mode EDMONDSON, M. D. The USAF Test Pilot School high angle of a and spin training program EDWARDS, D. H. Vibration test procedures for accessory an drive gearboxes on Atar 09c engines [AD-A105269] EIDELMAN, D. Fixed gain controller design for aircraft [AD-A104877] ELDER, R. J. Assessing pilot workload - Without disturb pilot behavior ELLEBBE, R. Design study report for General Aviation L. receiver [AD-A104921] ELLIOTT, C. T.	rared 1 A82-14779 ttack A82-14932 gle N82-12076 N82-12081 ing A82-14745 oran-C N82-12062	helicopter blade in forward flight [ONEBA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressuland airflow distribution for gas turbine combustors FARLEY, H. L. Experimental and analytical studies of advair cushion landing systems [NASA-CR-3476] FARMER, B. H. Real-time flight management avionics softw. [AIAA 81-2340] Flight management systems for modern jet a FARQUHAR, B. W. A large-scale investigation of engine inflinlet performance at angle-of-attack [AIAA PAPER 81-2481] FARREIL, B. J. Index of National Aviation Facilities Experenter technical reports 1972 - 1977 [AD-A104759] FRELAZZO, G. A criterion for determining the causes of shear at Punta Raisi Airport, on the bas.	A82-13992 re loss A82-15606 anced N82-12065 are system A82-13530 ircraft A82-14778 uence on A82-13939 rimental N82-12056
Rescue at sea BDGB, R. R. Weather impact on low-altitude imaging inf isensors in Europe - An availability mode EDMONDSON, M. D. The USAF Test Pilot School high angle of a and spin training program EDWARDS, D. H. Vibration test procedures for accessory an drive gearboxes on Atar 09C engines (AD-A105269) EIDELHAN, D. Fixed gain controller design for aircraft (AD-A104877) ELDER, R. J. Assessing pilot workload - Without disturb pilot behavior ELLEBBE, R. Design study report for General Aviation Lareceiver (AD-A104921)	rared 1 182-14779 ttack A82-14932 gle N82-12076 N82-12081 ing A82-14745 oran-C N82-12062 Army	helicopter blade in forward flight [ONEBA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressuand airflow distribution for gas turbine combustors FARLEY, H. L. Experimental and analytical studies of advair cushion landing systems [NASA-CR-3476] FARMER, B. H. Real-time flight management avionics softwork [AIAA 81-2340] Flight management systems for modern jet a FARQUHAR, B. W. A large-scale investigation of engine inflinlet performance at angle-of-attack [AIAA PAPER 81-2481] FARRELL, B. J. Index of National Aviation Facilities Expendent technical reports 1972 - 1977 [AD-A104759] FEBLIAZZO, G. A criterion for determining the causes of	A82-13992 re loss A82-15606 anced N82-12065 are system A82-13530 ircraft A82-14778 uence on A82-13939 rimental N82-12056
Rescue at sea **BDGB, R. R. Weather impact on low-altitude imaging inf isensors in Europe - An availability mode EDMONDSON, M. D. The USAP Test Pilot School high angle of a and spin training program EDWARDS, D. H. Vibration test procedures for accessory an drive gearbores on Atar 09C engines [AD-A105269] EIDELMAN, D. Pixed gain controller design for aircraft [AD-A104877] ELDER, R. J. Assessing pilot workload - Without disturb pilot behavior ELLERBE, R. Design study report for General Aviation In receiver [AD-A104921] ELLIOTT, C. T. Integration of controls and displays in US helicopter cockpits	rared 1 A82-14779 ttack A82-14932 gle N82-12076 N82-12081 ing A82-14745 oran-C N82-12062	helicopter blade in forward flight [ONEBA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressuland airflow distribution for gas turbine combustors FARLEY, H. L. Experimental and analytical studies of advair cushion landing systems [NASA-CR-3476] FARMER, B. H. Real-time flight management avionics softw. [AIAA 81-2340] Flight management systems for modern jet a FARQUHAR, B. W. A large-scale investigation of engine inflinlet performance at angle-of-attack [AIAA PAPER 81-2481] FARREIL, B. J. Index of National Aviation Facilities Experenter technical reports 1972 - 1977 [AD-A104759] FRELAZZO, G. A criterion for determining the causes of shear at Punta Raisi Airport, on the bas.	A82-13992 re loss A82-15606 anced N82-12065 are system A82-13530 ircraft A82-14778 uence on A82-13939 rimental N82-12056 wind is of
Rescue at sea ** ** ** ** ** ** ** ** ** ** ** **	rared 1	helicopter blade in forward flight [ONEBA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressurand airflow distribution for gas turbine combustors PARLEY, H. L. Experimental and analytical studies of advair cushion landing systems [NASA-CR-3476] PARBER, B. H. Real-time flight management avionics softwall [AIAA 81-2340] Flight management systems for modern jet a softwall [AIAA 81-2340] PARGUHAR, B. W. A large-scale investigation of engine inflicate performance at angle-of-attack [AIAA PAPER 81-2481] FARRELL, B. J. Index of National Aviation Facilities Experience of National Aviation Facilities Experience at Punta Raisi Airport, on the basistatistical data from barograph records PERRELL, P. J. Computer-in-control selection logic for a digital flight control system [AIAA 81-2236]	A82-13992 re loss A82-15606 anced N82-12065 are system A82-13530 ircraft A82-14778 uence on A82-13939 rimental N82-12056 wind is of
Rescue at sea **BDGB, R. R. Weather impact on low-altitude imaging inf sensors in Europe - An availability mode EDMONDSON, M. D. The USAF Test Pilot School high angle of a and spin training program EDWARDS, D. H. Vibration test procedures for accessory an drive gearbores on Atar 09C engines [AD-A105269] EIDELMAN, D. Fixed gain controller design for aircraft [AD-A104877] ELDER, R. J. Assessing pilot workload - Without disturb pilot behavior ELLEBBB, R. Design study report for General Aviation Lirecceiver [AD-A104921] ELLIOTT, C. T. Integration of controls and displays in US helicopter cockpits ELSEBARB, A. Evaluation of an experimental technique to investigate the effects of the engine po on engine/Fylcn/wing interference	rared 1	helicopter blade in forward flight [ONEBA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressurand airflow distribution for gas turbine combustors FARLEY, B. L. Experimental and analytical studies of advair cushion landing systems [NASA-CR-3476] FARMER, B. H. Real-time flight management avionics software [AIAA 81-2340] Flight management systems for modern jet a FARQUHAR, B. H. A large-scale investigation of engine inflinlet performance at angle-of-attack [AIAA PAPER 81-2481] FARREIL, B. J. Index of National Aviation Facilities Experiments of Sational Aviation Facilities Experiments and Center technical reports 1972 - 1977 [AD-A104759] FEBELAZZO, G. A criterion for determining the causes of Shear at Punta Raisi Airport, on the bass statistical data from barograph records PERRELL, P. J. Computer-in-control selection logic for a digital flight control system [AIAA 81-2236] FEBRIS, E. H. Application of a microprocessor controlled	A82-13992 re loss A82-15606 anced N82-12065 are system A82-13530 ircraft A82-14778 uence on A82-13939 rimental N82-12056 wind is of A82-15468 triplex A82-13465 cockpit
Rescue at sea BDGB, R. R. Weather impact on low-altitude imaging inf isensors in Europe - An availability mode EDMONDSON, M. D. The USAF Test Pilot School high angle of a and spin training program EDWARDS, D. H. Vibration test procedures for accessory an drive gearbores on Atar 09C engines [AD-A105269] EIDELMAN, D. Fixed gain controller design for aircraft [AD-A104877] ELDER, R. J. Assessing pilot workload - Without disturb pilot behavior ELLERBE, R. Design study report for General Aviation In receiver [AD-A104921] ELLIOTT, C. T. Integration of controls and displays in US helicopter cockpits ELSEBAR, A. Evaluation of an experimental technique to investigate the effects of the engine po on engine/Fylcn/wing interference EMBLIANOV, V. B. Quality optimization and unification of av	rared 1	helicopter blade in forward flight [ONEBA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressuand airflow distribution for gas turbine combustors FARLEY, H. L. Experimental and analytical studies of advair cushion landing systems [NASA-CR-3476] FARBER, B. H. Real-time flight management avionics software [AIAA 81-2340] Flight management systems for modern jet a FARQUHAR, B. W. A large-scale investigation of engine inflinet performance at angle-of-attack [AIAA PAPER 81-2481] FARRELL, B. J. Index of National Aviation Facilities Experence of the National Aviation Facilities Experence of Shear at Punta Raisi Airport, on the basistatistical data from barograph records PERRELL, P. J. Computer-in-control selection logic for a digital flight control system [AIAA 81-2236] PERRIS, E. W. Application of a microprocessor controlled display for enhanced pilot control of flest maneuvers	A82-13992 re loss A82-15606 anced N82-12065 are system A82-13530 ircraft A82-14778 uence on A82-13939 rimental N82-12056 wind is of A82-15468 triplex A82-13465 cockpit
Rescue at sea BDGB, R. R. Weather impact on low-altitude imaging infinensors in Europe - An availability mode EDMONDSON, M. D. The USAF Test Pilot School high angle of a and spin training program EDWARDS, D. H. Vibration test procedures for accessory andrive gearboxes on Atar 09C engines [AD-A105269] EIDELHAN, D. Fixed gain controller design for aircraft [AD-A104877] ELDER, R. J. Assessing pilot workload - Without disturb pilot behavior ELLEBBE, R. Design study report for General Aviation Lircrectiver [AD-A104921] ELLIOTT, C. T. Integration of controls and displays in US helicopter cockpits ELSEBARE, A. Evaluation of an experimental technique to investigate the effects of the engine poon engine/Fylcn/wing interference	rared 1	helicopter blade in forward flight [ONEBA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressurand airflow distribution for gas turbine combustors FARLEY, B. L. Experimental and analytical studies of advair cushion landing systems [NASA-CR-3476] FARBER, B. H. Real-time flight management avionics software [AIAA 81-2340] Flight management systems for modern jet a FARQUHAR, B. W. A large-scale investigation of engine inflinlet performance at angle-of-attack [AIAA PAPER 81-2481] FARREIL, B. J. Index of National Aviation Facilities Experience technical reports 1972 - 1977 [AD-A104759] FEBLIZZO, G. A criterion for determining the causes of shear at Punta Raisi Airport, on the basistatical data from barograph records FEBRELL, P. J. Computer-in-control selection logic for a digital flight control system [AIAA 81-2236] FEBRIS, E. W. Application of a microprocessor controlled display for enhanced pilot control of flitest maneuvers [AIAA PAPER 81-2510] FILAESKY, S. F.	A82-13992 re loss A82-15606 anced N82-12065 are system A82-13530 ircraft A82-14778 uence on A82-13939 rimental N82-12056 wind is of A82-15468 triplex A82-13465 cockpit
Rescue at sea BDGB, R. R. Weather impact on low-altitude imaging inf isensors in Europe - An availability mode EDMONDSON, M. D. The USAF Test Pilot School high angle of a and spin training program EDWARDS, D. H. Vibration test procedures for accessory an drive gearbores on Atar 09C engines [AD-A105269] EIDELMAN, D. Fixed gain controller design for aircraft [AD-A104877] ELDER, R. J. Assessing pilot workload - Without disturb pilot behavior ELLERBE, R. Design study report for General Aviation In receiver [AD-A104921] ELLIOTT, C. T. Integration of controls and displays in US helicopter cockpits ELSEBAR, A. Evaluation of an experimental technique to investigate the effects of the engine po on engine/Fylcn/wing interference EMBLIANOV, V. B. Quality optimization and unification of av	rared 1	helicopter blade in forward flight [ONEBA, TP NO. 1981-89] PAN, ZM. Experimental investigation of total pressuand airflow distribution for gas turbine combustors FARLEY, H. L. Experimental and analytical studies of advair cushion landing systems [NASA-CR-3476] FARMER, E. H. Real-time flight management avionics softwork [AIAA 81-2340] Flight management systems for modern jet a FARQUHAR, B. W. A large-scale investigation of engine inflinlet performance at angle-of-attack [AIAA PAPER 81-2481] FARRELL, E. J. Index of National Aviation Facilities Experiments (AIAA PAPER 81-2481) FERLAZZO, G. A criterion for determining the causes of shear at Punta Raisi Airport, on the bas statistical data from barograph records PERRELL, P. J. Computer-in-control selection logic for a digital flight control system [AIAA 81-2236] FERRIS, E. W. Application of a microprocessor controlled display for enhanced pilot control of fl test maneuvers [AIAA PAPER 81-2510]	A82-13992 re loss A82-15606 anced N82-12065 are system A82-13530 ircraft A82-14778 uence on A82-13939 rimental N82-12056 wind is of A82-15468 triplex A82-13465 cockpit

A82-13968

FISH, B. B. grperimental and analytical studies of advair cushion landing systems	anced	GARNIBR, JL. Large terminal maneuvering areas: Operatio problems - Possible development of solut	
[NASA-CR-3476]	N82-12065		A82-15625
FISHER, B. D. Thunderstorm hazards flight research - Pro	ogram	GEARHART, L. The design and implementation of a canned	
OVERVIEW	100 1000	function for the P-16 dynamic system sim	
[AIAA PAPER 81-2412] Operational evaluation of thunderstorm pen	A82-13853	CPD1 .1	A82-14678
test flights during project Storm Hazard		GERA, J. Flight test experience with high-alpha con system techniques on the F-14 airplane	trol
FISHER, J. J. The Navy P/A-18A Hornet electromagnetic		[ÂIAA PAPER 81-2505] GERDES, R. H.	A82-13906
compatibility program	A82-14760	The X-14 - 24 years of V/STOL flight testi	ng A82-14927
PLITCHOFT, J. E.		GIACCARI, E.	
Prediction and measurement of time-variant three-dimensional flows in military airc intakes		A new approach to radar plot extraction fo applications	r ATC A82-14908
BY OR DORC I D	N82-13069	GIBBS, G. D.	
PLODROPS, J. P. Transonic flows in an air inlet with large	3	Enhanced F-15 air-to-ground flight demonst [AIAA PAPER 81-2413]	rations A82-13854
incidence and the effect of a blowing tr		GIBSON, H. M.	102 1303
	N82-13071	Flight testing De Havilland Aircraft Limit	
PLORES, A. Portable air driven variable speed fiber of	ontic	DASH-8 utilizing onboard data analysis b	y
cable termination polisher	-p-110	[AIAA PAPER 81-2507]	A82-13907
[AD-A104797]	N82-12448	GILL, R. A.	
FORBER, W. Effects of aerodynamic coupling on the dyn	namice of	Advanced fighter technology integration AF test program overview	TI/F-16
roll aircraft	MARICS OI	[AIAA PAPER 81-2353]	A82-14398
1	N82-12070	GIULI, D.	
FOOTE, A. Applications of covariance analysis simula	ation to	Performance evaluation of target report ex in the monopulse ATCRBS	tractor
avionics flight testing		In the Monopulate Michiga	A82-14776
noncell C	A82-14767	A multimicroprocessor system for ATCRBS mo	nopulse
PORGHAM, S. L. The use of metal finishing in aircraft fue	el systems	data processing	A82-14777
_	N82-12077	GLIDEWELL, R. J.	
PORMASIER, L.	1-	Advanced exhaust nozzle technology	WOO 42070
Subsonic military aircraft engine intake: integrated theoretical experiment design		GOLD, D.	N82-13078
	N82-13073	A look at the Hoffman Triangular parachute	- The
FOSSI, 8. Performance evaluation of target report ex	*+Tactor	first successful glidable parachute	A82-14966
in the moncpulse ATCRES	reractor	GOLDBERG, J.	A02 14900
TOUTE C. P.	A82-14776	The SIPT computer and its development	-00 43/10/
FOSTER, C. R. Operational evaluation of the new generation	on of	[AIAA 81-2278] GOLDSHITH, B. L.	A82-13490
jet transport aircraft		Effects of intake geometry on circular pit	ot
[AIAA PAPER 81-2377] POSTER, W. D.	A82-13942	intake performance at zero and low forwa	rd speeds. .n82-1307
Collection and simulation of spatial infra	ared	GOLUBRY, B.	NO2-1307
signatures of military jet aircraft		A synthesis technique for highly uncertain	
[AIAA PAPER 81-2494] FOX, D.	A82-13921	interacting multivariable flight control	systems A82-14827
Computer simulation of an advanced aircraf	f t	GONTABOVSKII, V. P.	A02-1402
electrical system	100 1000	Study of the load-carrying capacity of avi	
FRANKLIN, S. N.	A82-14821	<pre>gas-turbine engine impellers under low-c loading at normal and high temperatures</pre>	Acte
Integrated flight testing based on conline		rearray at notice and major temporation	A82-15482
system identification data processing to [AIAA PAPER 81-2449]	echniques A82-14389	GOODCHILD, W.	o radar
Robust flight control - A design example	POT : 14703	<pre>Moving target Detector/Airport Surveillanc (ASE-7) field evaluation</pre>	
	A82-15845	[AD-A105196]	N82-1230
FRASES, E. F. In-flight computation of helicopter transmission	mission	GOODMAN, H. A. Reliability analysis of the F-8 digital	
fatigue life expenditure	100101	fly-by-wire system	
[AIAA PAPEE 81-2434]	A82-13872	[NASA-CR-163110]	N82-12079
PRIBS, G. H. Heavy lift helicopters - A national techno	ology	GOODSOM, B. Civil aviation in China	
opportunity			A82-1360
	A82-13241	GORBUNOV, M. N. The technology of sheet-metal stamping in	the
		production of aircraft /2nd revised and	
G		edition/	
GAGLIABI, J. Pormulation and characterization of polyimation and characterization of polyimatical polyimatic	nide	GORDOS, D. L.	A82-1499
resilient foams of various densities for	 t	Georgia Tech coherent jammer flight test	
aircraft seating applications	NO242222	[AIAA FAPER 81-2452]	A82-1389
[BASA-CR+167421] GALLAGHER, J.	N82-12230	GORODETSEIL, V. G. Optimization of requirements on the	
Instrumentation to determine the suitabili	ity of	pitting-prevention properties of turboje	et-engine
<pre>BNAV systems for helicopter navigation i pational airspace system /NAS/</pre>	in the	oils	A82-1572
(AIAA PAPER 81-2514)	A82-13911	GOVINDARAJ, K. S.	
		Modeling procedures for handling qualities evaluation of flexible aircraft	ī

PERSONAL AUTHOR INDEX HOCKNEY, B. W.

GRABE, W. Compressor stall inducing installation eff an engine control parameter for the CF-5		HARRIS, D. J. Hover tests of the XV-15 Tilt Rotor Research Aircraft	
GRABOWSKY, J. P.	N82-13085	HARRIS, B. L.	2-14386
Pave Mover Flight Test Program [AIAA PAPEE 81-2492]	A82-14380		2-14720
GRAPE, P. H. An analysis of civil aviation propeller-to- accidents: 1965-1979 [AD-A105365]	-person N82-12053	HARRISON, A. J. The history of the development of the GQ aeroconical paracoute - 1971-1980	2-14961
GRAVELY, W. L. The influence of smart computers on the couthe future		HARROLD, G. B. Light-guided information distribution systems	
GREEN, D. E.	A82-14743	BART, D. L. Pailure analysis of variable reluctance stepp	er
Advanced display systems for crew stations tactical aircraft	of	motor A8	2-14792
[AIAA 81-2312] GRBY, J.	A82-13514	HARVEY, C. A. Wing/store flutter - An active adaptive contr	ol
Aeronautics in China - An AIAA report	A82-13150	application A8	2-13122
GRIEB, H. Comparison of different nozzle concepts for reheated turbofan	r a	BASSABEISSA, A. A. Subcritical and supercritical airfoils for gr pressure distribution	
GRIFFITH, B. J.	N82-13077	HATPIBLD, J. J.	2-12031
Overview of flight and ground testing with emphasis on the wind tunnel [AIAA PAPER 81-2474]	A82-13928	An advanced programmable/reconfigurable color graphics display system for crew station technology research	
GRIMES, B. ATARK laser tracking system GROSS, J. P.	A82-13016	A unique integrated flight testing facility f advanced control/display research	2-13516 or 2-13919
Techniques for interfacing multiplex system	ns N82-13135	Experimental evaluation of a perspective tunn display for three-dimensional helicopter approaches	
Model testing techniques for measuring inl	et drag N82-13084		2-15847
GRUHWALD, A. J. Experimental evaluation of a perspective t display for three-dimensional helicopter		An update of an integrated CNI system - TIES [AIAA 81-2292] A8 HEALY, R. D.	2-13500
approaches	A82-15847	Updated station deselection procedures to sup automatic Omega receiver operation	-
GRYSON, P. Transonic flows in an air inlet with large incidence and the effect of a blowing transcription.		HEATON, H. L. Chemistry of combustion of fuel-water mixture	2-14712 s 2-12178
GUPTA, R. R. Updated station deselection procedures to automatic Cmega receiver operation	support	EEGNA, H. A. The numerical solution of incompressible turb flow over airfoils	ulent
GUTRNEY, B. S.	A82-14712	N 8	2-12030
Optimization of requirements on the pitting-prevention properties of turboje oils	t-engine	Navigation for helicopters by multiple use of inertial sensors	2-14713
	A82-15723	BENDRICKSON, J. F. Aircraft alerting systems standardization stu	
HABERLAND, S.		HENLINE, J. C.	2" 13400
Wing design for light transport aircraft w improved fuel economy	ith A82-14416	Columbus, Ohio, Voice response system demonstration and evaluation [AD-A104750] N8	2-12304
HAMILTON, B. G., JR. Digital avionics display processor		F-15 SAR	2-14938
[AIAA 81-2311] HANSON, D. C.	A82-13513	HILAIRE, G. Advantages and limitations of various materia	
Aircraft alerting systems standardization [AIAA 81-2242] HANSCE, B. G.	study A82-13468	used in the construction of modules	2-12072
Automatic digital gain ranging [AIAA PAPEE 81-2370] HARPER, L. B.	A82-13947	The need for, and development of, a simulatio facility at the Naval Air Test Center	n 2-13917
The subsonic performance of practical mili variable area convergent nozzles	tary N82-13076	BINDS, B. KC-10 flight test program	2-14935
HARRIS, A. B.		HINDS, J. L.	
Wind tunnel test and analysis techniques u powered simulators for civil nacelle installation drag assessment	N82-13088	Analytical and experimental characterization the JAU-14/A cartridge actuated initiator f use in aircrew escape system performance evaluation	
Establishment of an experimental technique provide accurate measurement of the inst	alled	HISSONG, S. J.	2-14985
drag of close coupled civil nacelle/airf configurations, using a full span model turbine powered engine simulators	rane	Microprocessor flight control application stu	dy 2-14796
-	N82-13089	Rapid elliptic solvers	2-15827

HODDEB, B. K. A large-scale investigation of engine infl	uence on	.l	
inlet performance at angle-of-attack [AIAA PAPER 81-2481]	A82-13939	JACOBSON, I. D.	
HOPPHAN, R. Airborne Electronic Map Systems. I - Desig		Transportation systems evaluation methodol development and applications, phase 3	
HOLBERG, D. B.	A82-14770	[NASA-CE-164999] JAKOB, H.	N82-12051
Pave Mover Flight Test Program [AIAA PAPEE 81-2492]	A82-14380	Calculation of wing-body-nacelle interfere subsonic and transonic potential flow	nce in
HOLCROFT, J. D.		-	N82-13095
Radar hostile fire location HOLDHUSEE, J. S.	A82-14857	JAKOBOVITS, R. H. Helicopter reliability and maintainability during development and production	trends
Model testing techniques for measuring inl	let drag N82-13084	(AD-A105775)	N82-13136
HOOVER, W. M. Passive terrain following using stored map		JAMESON, A. Remarks on the calculation of transonic pofilow by a finite volume method	
global positioning system	A82-14772	JARRETT, D. N.	A82-15835
HOPKIES, A. L., JR. On-board communication for active-control transport aircraft		Use of a helmet-mounted matrix display for presenting energy-maneuverability inform during simulated close combat	
[AIAA 81-2321]	A82-13520		N82-13061
HORNUNG, G. Structural dynamics: Modified calculation [BMVG-FBWT-81-1]	ns N82-13457	JEFFCOAT, R. L. Experimental and analytical studies of adv air cushion landing systems	anced
HOROWITZ, I.	and	[NASA-CR-3476]	N82-12065
A synthesis technique for highly uncertain interacting multivariable flight control		JENKINS, E. E. Creep and aero gas turbine design	A82-12987
HOWARD, P. J.		JEHNINGS, G. L.	202 .250.
Plight trail of the Aircraft Patigue Data System (APDAS) Bk 2 prototype	Analysis	F-15 SAR	A82-14938
[AD-A105270] HUMPHREY, C. H.	N82-12066	JENSEE, R. S. Computer-animated predictive displays for	
Airplane performance sensitivities to late vertical profiles	eral and	microwave landing approaches	A82-15816
HURLBURT, G. P.	A82-15846	JIRAN, P. Techniques for modifying airfoils and fair	INGS OR
Information technology and its impact on t evaluation at the Naval Air Test Center		aircraft using foam and fiberglass [AIAA PAPER 81-2445]	∆82-14383
[AIAA PAPER 81-2396]	A82-13894	JOHNESON, D. C. Evaluation of a selected group of anti-exp garment configurations for their effects operational performance and survival of	on the
IAKOVLEVA, A. P.		alicreamen	
Efficient use of working fluids in aviation bydraulic systems	on.	JOHNSON, W.	A82-14972
IARLYKOV, M. S.	A82-15724	Development of a comprehensive analysis fo rotorcraft. II - Aircraft model, solutio	
Estimation of the efficiency of radicelect flight navigation systems		procedure and applications	A82-14407
IATESTA, J. J.	A82-13701	V	
HASEP - Survival from crashed Navy belicop	ters 14977	KANDAGAI, R.	
ILIPP, K. W. Selected stability and control derivatives the first Space Shuttle entry	s from	Digital control for flexible aircraft usin reduced order models	.g
[AIAA PAPER 81-2451]	A82-13880	KARPBL, M.	
ILIN, V. B. Current aerial cameras		Design for active and passive flutter supp and gust alleviation	ression
INAGAKI, R.	A82-15655	[NASA-CR-3482] KBLLEY, W. W.	N82-13147
Extended time radar raw Wideo recording	A82-14909	Limited evaluation of an F-14A airplane ut an aileron-rudder interconnect control s	
Air-to-ground MTI radar using a displaced	phase	the landing configuration [NASA-TM-81972]	N82-13148
center, phased array	A82-14881	<pre>KELLY, R. J. Joint Tactical Microwave Landing System /J</pre>	THIS/
INNIS, R. C. Powered-lift takeoff performance character	istics	airborne signal processing [AIAA 81-2247]	A82-13471
<pre>determined from flight test of the Quiet Short-haul Research Aircraft /QSRA/</pre>		KESSLER, I. J. Avionics implications from weapon system	
[AIAA PAPEE 81-2409] Powered-lift STOL aircraft shipboard opera		operational utility studies on Hanned Ai Simulators	
A comparison of simulation, land-based a trial results for the QSRA	and sea	[AIAA 81-2230] KETTERRR, J. R.	A82-1346
[AIAA PAPER 81-2480] INCUE, S.	A82-13938	The Navy P/A-18A Hornet electromagnetic compatibility program	
An aerodynamic design and the overall stag			A82-1476
performance of an air-cooled axial-flow [NAL-TR-321T]	turbine N82-13109	KEYSEB, G. L. Thunderstorm hazards flight research - Pro	gram
		OVETVIEW [AIAA PAPER 81-2412]	A82-1385

KEYSER, G. L., JR. Operational evaluation of thunderstorm pene test flights during project Storm Hazards		KRICKE, R. D. Technical/operational ATC scenarios for fut navigation	ure TBA
KIH, H. Y.		KUEBRICH, R. L.	202 14174
Enhanced aircraft bandling qualities by longitudinal dynamics mode decoupling		Improved techniques for the calibration and measurement of in-flight loads	
KIMBERLIE, R. D.	A82-14826	[AIAA PAPER 81-2502] KUHLTHAU, A. B.	A82-13924
Ball-Bartoe Jetwing flight tests	A82-14928	Transportation systems evaluation methodolo development and applications, phase 3	
KIBCAID, B. B. Advanced fiber optic systems for avionics applications		[NASA-CR-164999] RULPAB, B. H. Alrframe-propulsion system aerodynamic	N82-12051
[AIAA 81-2319] KINGSLEY, R. J.	A82-13518	interference predictions at high transons numbers including off-design engine airfi	
Development of a lifting parachute to provi self-dispersing capability for an Avco-de		effects	N82-13098
tactical munition		KULWICKI, P. V.	
KIRAH, H. S.	A82-13962	A methodology for missile launch envelope of evaluation	
A cost effective method for the control of	roll		A82-14744
	A82-13861	Numerical analysis of the scramjet-inlet fl	
Planning a helicopter flight test program [AIAA PAPER 81-2381]	A82-13881	field by using two-dimensional Navier-Sto	okes
KIRDAKOV, B. P.		[NASA-TP-1940] KOPPOSWAMY, K.	N82-13142
Optimization of requirements on the pitting-prevention properties of turbojet	-engine	Planning a helicopter flight test program	- 00 - 1000 -
oils	A82-15723	[AIAA PAPER 81-2381]	A82-13881
KIRKHAM, W. R. An analysis of civil aviation propeller-to-	-person	L	
accidents: 1965-1979	F	LAMB, M.	
[AD-A105365]	N82-12053	Pressure distributions on three different	
KLBVBHHUSEB, K. D. Calculation of wing-body-nacelle interferen	nce in	cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and	3.70.
subsonic and transonic potential flow	N82-13095	Volume 1: Trapezoidal tail [NASA-TM-80097]	N82-13110
KLIBE, C. S. Airborne Electronic Terrain Map System. II	-	LAMBERGTS, A. A. Development of an MLS lateral autoland syst	tem with
Applications	A82-14773	automatic path definition [AIAA PAPER 81-1751]	A82-13993
KLOSTER, H.		LABCASTER, T. C.	
System identification belicopter parameters Determination from flight tests, phase 2	S.	Information technology and its impact on to evaluation at the Naval Air Test Center	est and
[BMVG-FBWT-80-12] KNAPP, L.	N82-13137	[AIAA PAPER 81-2396] LANG, J. D.	A82-13894
Technical/operational ATC scenarios for fut navigation	ture TMA	Organizing and training for innovative flag	ght test
-	A82-14774	[AIAA PAPER 81-2416]	A82-13856
KNAUS; A. A technique to determine lift and drag pola	ars in	General purpose real-time interaction pane.	l for
flight and their application [AIAA PAPER 81-2420]	A82-13859	digital simulation	A82-14831
KBEELAND, B. T., JR.		LAPRAD, R. F.	
F/A-18 high authority/blgh gain digital fli control system development and flight tes	ight st1na	Sensor failure detection system [NASA-CR-165515]	N82-13145
[AIAA PAPER 81-2465]	A82-13930	LARGE, R. Status and tracking system for flight test	data
The influence of wind shear and vertical wi	inds on	products	A82-14376
takeoffs and go-arounds	A82-15823	[AIAA PAPER 81-2395] LARUBLLE, G.	
Experimental investigation of a helmet moun	nted	An acquisition and analysis system for dynates tests of air inlets	anic
sight/display for helicopter	N82-13060	LASAGNA, P. L.	N82-13082
KOHNHORST, L. L. Direct digital drive actuation		Recent propulsion system flight tests at the Dryden Flight Research Center	he NASA
[AIAA 81-2298]	A82-13505	[AIAA PAPER 81-2438]	A82-13874
ROMCSEK, J. Performance of highly integrated inlets for	:	Determination and analysis of jet and miss:	le fuel
supersonic aircraft	N82-13066	deposits [AD-A105458]	N82-12248
Investigation of acoustic interactions in	jet	The influence of closed-coupled, rear fuse	
thrust augmenting ejectors [AD-A106083]	N82-13835	mounted nacelles on the design of an adva high speed wing	
KRAUSPE, P. The influence of wind shear and vertical wi	inds on	LAUGHRBY, J. A.	N82-13092
takeoffs and go-arounds	A82-15823	Integration of advanced exhaust nozzles	N82-13075
KREIPELDT, J. G.		LAVIB. E. P.	
Low cost programmable multisimulator facili [AIAA 81-2229]	ity 182-13534	Light-guided information distribution system [AIAA 81-2320]	ems A82-13519
RRRIBDLES, B. Darboux points in minimum-fuel aircraft lar	nding		
problems			

A82-13077

PERSONAL AUTHOR INDEX LAWRENCE, D.

LAWBENCE, D.	1 . 1	LINE, W. A.	
The use of groundspeed, in a wind shear an flight evaluation of a radar-altimeter-b		Flight evaluation of LOBAN-C as a helicopt navigation aid in the Baltimore Canyon of	
system for the measurement of groundspee		exploration area	**
[AD-A104758]	N82-12060	[AD-A105260]	N82-12059
LAWRENCE, D. L. Flight test method for the determination o	f	LYONS, V. J. Effect of fuel-air-ratio nonuniformity on	
reciprocating engine cocling requirement		emissions of nitrogen oxides	
[AIAA PAPEE 81-2446]	A82-13878	[BASA-TP-1798]	N82-13143
LAWSON, P. Trim tab excitation system for the BAe 146			
1111 110 010-0101- 1/0001 101 010 010	A82-14363	M	
LBE, B. G. S.		MACHILLAN, A. J.	
Experimental and analytical studies of adv air cushion landing systems	anced	Navstar Global Positioning System flight to program overview	est
[NASA-CR-3476]	N82-12065	[AIAA PAPER 81-2350]	A82-13956
LEE, E. Formulation and characterization of polyim	ide	MACHILLAN, W. L. Compressor stall inducing installation effort	octs of
resilient foams of various densities for		an engine control parameter for the CF-5	alccraft
aircraft seating applications	NO2 42220		N82-13085
[NASA-CR-167421] LEFFLER, M. P.	N82-12230	MACHAB, B. Testing of the SJU-5A ejection seat for the	e P/A-18
Aircraft alerting systems standardization		/HCRNET/ aircraft	,
[AIAA 81-2242]	A82-13468	MATER D D	A82-14955
A numerical method for studying		MAINE, R. B. Selected stability and control derivatives	from
nacelle-jet-airfcil interaction in invis	cid	the first Space Shuttle entry	
three-dimensional flow	N82-13094	[AIAA PAPER 81-2451] HAISEL, H. D.	A82-13880
LENZ, R. C.	202 10074	Hover tests of the XV-15 Tilt Rotor Research	ch
The payoff from U.S. investment in aeronau	tical	Aircraft	
research and development	A82-14793	[AIAA PAPER 81-2501] MALICE, J. D.	A82-14386
LEONG, P.		Weather impact on low-altitude imaging inf.	
Conceptual design of an integrated power a avicnics information system	nd	sensors in Europe - An availability mode	1 A82-14779
avicates farotmation system	A82-14788	MANTAY, W. R.	A02-14773
LBUIS, H. D.		Wind-tunnel investigation of the effects of	
Using phased array radar for data communic	ations A82-14725	tip geometry on the interaction of torsa loads and performance for an articulated	
LEYNABRT, J.		helicopter rotor	
Studies of air inlets at Reynolds numbers comparable to flight in CNEBA's F1 and S	1Ml wind	[NASA-TP-1926]	N82-13107
tunnels	1DA WILL	BABEK, A. J. Computer simulation of an advanced aircraf	t
	N82-13091	electrical system	
LILLEY, E. W. A Loran-C prototype navigation receiver fo	r	MARGASON, R. J.	A82-14821
general aviation		Jet V/STOL wind-tunnel simulation and grou	ndplane
[AIAA 81-2329] MLS performance assessment, task 4. Volum	A82-13532	effects	A82-13973
Evaluation procedures and equipment desi		HARGO, C. S.	MOZ 13373
[AD-A105393]	N82-12061	A matter of seconds - A critical account o	
LIMBREY, B. Post ejection survival		notable air disasters /5th Hajor Hiller Lecture/	Hemorial
	A82-14981	·	A82-15597
LING, A. C. Fire extinguishant materials		MARKS, R. B. A new approach to modeling the cost of own	ershin
[NASA-CASE-ARC-11252-1]	N82-12168	for aircraft systems	-
Development and testing of dry chemicals i advanced extinguishing systems for jet e		[AD-A104434]	N82-13979
nacelle fires	ngine	HARQUART, B. J. Evaluation and wind tunnel tests of the 4,	000 lb
[NASA-CR-165011]	N82-13186	(normal-force) pitch/yaw and roll dynami	C
LIVINGSTON, R. B. Sunmary of Federal Aviation Administration		stability balance systems for measuring cross, and cross-coupling derivatives	direct,
responses to National Transportation Saf		[AD-A105122]	N82-12047
Board safety recommendations [AD-A104922]	N82-12055	MARTIE, J. L. Powered-lift takeoff performance character	istics
LOGAN, N. B.		determined from flight test of the Quiet	
The Maneuvering Flight Path Display - A fl	1ght	Short-haul Research Aircraft /QSRA/	*02 12052
trajectory solution display concept	A82-14824	[AIAA PAPER 81-2409] Powered-lift STCL aircraft shipboard opera	A82-13852 tions -
LOVERA, B.		A comparison of simulation, land-based a	
The Agusta A129	A82-13237	trial results for the QSRA [AIAA PAPER 81-2480]	A82-13938
LOWE, J. R.		MARTINO, J. D.	
Applications of head-up displays in commer transport aircraft	cial	Analytical and experimental characterizata	
[AIAA 81-2300]	A82-13506	the JAU-14/A cartridge actuated initiato use in aircrew escape system performance	
LU, J.		evaluation	.00 40005
A new approach to modeling the cost of own for aircraft systems	eronth	MARTÍBOB, J.	A82-14985
[AD-A104434]	N82-13979	Three dimensional flow investigation with	
LUCCHI, G. A. Commercial airborne weather radar technology	VΦV	of characteristics in the inlet region a blade-to-blade channels of supersonic ax	
	A 82-14868	Compressors	
LUEDDE, W. J.			
The use of separated multifunction incrtic	1	[BSA-TT-637]	ม82-12078
The use of separated multifunction inertia sensors for flight control	1	[ESA-TT-637]	N82-12078

PERSONAL AUTHOR INDEX

MASSEY, B. G.	BEBDI, I. S.
A new approach to modeling the cost of ownership	Will power-by-wire replace power-by-hydraulics
for aircraft systems [AD-A104434] N82-139	79 MBLOCCO, J. M.
MASTRULLO, A. R.	Using voice control onboard combat aircraft
An analysis of civil aviation propeller-to-person	N82-13056
accidents: 1965-1979	MERUTRA, J. P.
[AD-A105365] N82-120	53 Progress in protective coatings for aircraft gas turbines: A Review of NASA sponsored research
Himat aerodynamic design and flight test experience	
[AIAA PAPEE 81-2433] A82-138	
MAGRBAG, C.	The design of exact nonlinear model followers
Head up displays	A82-13125
MAY, W.	152 Application of the concept of dynamic trim control and nonlinear system inverses to automatic
Status and tracking system for flight test data	control of a vertical attitude takeoff and
products	landing aircraft
[AIAA PAPER 81-2395] A82-143	
MAYRR, L. A. Fire extinguishant materials	<pre>BEYER, M. B. Techniques for modifying airfoils and fairings on</pre>
[NASA-CASE-ABC-11252-1] N82-12	
Development and testing of dry chemicals in	[AIAA PAPER 81-2445] A82-14383
advanced extinguishing systems for jet engine	BICCICBB, J.
nacelle fires [NASA-CR-165011] N82-13	HASEF - Survival from crashed Navy helicopters A82-14977
MAYO, N. B.	MIHALORN, J. R.
On matching the systems identification technique	A real time Pegasus propulsion system model for
to the particular application	VSTOL piloted simulation evaluation
MCCALL, D. L.	19 [NASA-TM-82770] N82-13144 NILES, B. B.
A Loran-C prototype navigation receiver for	Digital detection and processing of laser beacon
general aviation	signals for aircraft collision hazard warning
[AIAA 81-2329] A82-135	
MCCORNICK, W. S. A recursive time domain analysis of distributed	MILEY, S. J. Plight test method for the determination of
line grid networks with application to the	reciprocating engine cooling requirements
LTA/EMP problem	[AIAA FAPEE 81-2446] A82-13878
A82-147	
MCCOBB, J. W. Higher order Information Transfer Systems are com-	A decoupled control system for improved flight ng performance in wind shear
[AIAA 81-2317] A82-139	
MCDOHHELL, J. D.	HILLER, 6.
Applications of digital avionics to commercial	Software considerations in the design of computer
transport aircraft - The DC-9 Super 80 and beyon	Software considerations in the design of computer design of generated flight displays
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134	Software considerations in the design of computer d generated flight displays 156 A82-14742
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCFADDEM, P. D. Vibration test procedures for accessory angle	Software considerations in the design of computer dd generated flight displays 156 A82-14742 MIMURA, P. An aerodynamic design and the overall stage
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDBH, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines	Software considerations in the design of computer design of computer generated flight displays A82-14742 MIMURA, P. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDEM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-120	Software considerations in the design of computer generated flight displays A82-14742 MIMURA, F. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TE-321T] NE2-13109
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDBH, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines	Software considerations in the design of computer generated flight displays 156 MIMURA, P. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TE-321T] MIRACLE, D. B.
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDBH, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-120 MCPABLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design	Software considerations in the design of computer generated flight displays 156 NBURA, F. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TR-321T] N82-13109 HIRACLE, D. B. Study of the effects of maneuver compensation on beam pointing accuracy
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDEM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-126 MCPARLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-126	Software considerations in the design of computer generated flight displays 82-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-13109 832-13109 832-13109 832-14780
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCFADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-120 MCFARLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-120 MCGILL, I. R.	Software considerations in the design of computer generated flight displays A82-14742 MIMURA, P. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-IE-321T] N82-13109 MIRACLE, D. R. Study of the effects of maneuver compensation on beam pointing accuracy A82-14780 MOCHII, B.
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDEM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-126 MCPARLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-126	Software considerations in the design of computer generated flight displays 82-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-13109 832-13109 832-13109 832-14780
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDEN, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-126 MCPARLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-126 MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating A82-143	Software considerations in the design of computer generated flight displays 156 NIMURA, P. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TR-321T] N82-13109 HIRACLE, D. B. Study of the effects of maneuver compensation on beam pointing accuracy A82-14780 HOCHII, B. Extended time radar raw wideo recording A62-14909
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCFADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-120 MCFABLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-120 MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLOBE, H. E.	Software considerations in the design of computer generated flight displays A82-14742 MIMURA, F. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-IE-321T] N82-13109 MIRACLE, D. R. Study of the effects of maneuver compensation on beam pointing accuracy A82-14780 MOCHII, B. Extended time radar raw video recording A62-14909 A64 MONTOYA, B. J. An advanced programmable/reconfigurable color
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCFADDBH, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-120 MCFABLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-120 MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLONE, M. E. Sensor failure detection system	Software considerations in the design of computer generated flight displays 156 NHURA, F. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-IB-321T] N82-13109 HIRACLE, D. R. Study of the effects of maneuver compensation on beam pointing accuracy 161 MOCHII, H. Extended time radar raw wideo recording 164 MONTOYA, R. J. An advanced programmable/reconfigurable color graphics display system for crew station
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCFADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-120 MCFABLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-120 MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLOBE, H. E.	Software considerations in the design of computer generated flight displays A82-14742 BIMURA, P. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TR-321T] N82-13109 HIRCLE, D. R. Study of the effects of maneuver compensation on beam pointing accuracy A82-14780 HOCHIL, B. Extended time radar raw wideo recording A62-14909 An advanced programmable/reconfigurable color graphics display system for crew station
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-120 MCPARLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-120 MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLONE, H. E. Sensor failure detection system [NASA-CR-165515] N82-13 MCGREGOR, I. Some BAE research on shielded and unshielded	Software considerations in the design of computer generated flight displays A82-14742 MIMURA, F. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-IE-321T] N82-13109 MIRACLE, D. R. Study of the effects of maneuver compensation on beam pointing accuracy A82-14780 MOCHII, M. Extended time radar raw video recording A62-14909 A64 MONTOYA, E. J. An advanced programmable/reconfigurable color graphics display system for crew station technology research [AIAA 81-2314] A82-13516 MORBLIO, S. A.
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-126 MCPABLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-126 MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLUB, H. B. Sensor failure detection system [NASA-CR-165515] N82-137 MCGREGOR, I. Some RAE research on shielded and unshielded fuselage mounted air intakes at subsonic and	Software considerations in the design of computer generated flight displays 156 NHURA, F. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-IR-321T] N82-13109 HIRACLE, D. R. Study of the effects of maneuver compensation on beam pointing accuracy 161 MOCHII, B. Extended time radar raw wideo recording 164 MOBTOIA, B. J. An advanced programmable/reconfigurable color graphics display system for crew station technology research [AIAA 81-2314] A82-13516 MORELLO, S. A. Have we overlooked the pilot's role in an
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-120 MCPARLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-120 MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLONE, H. E. Sensor failure detection system [NASA-CR-165515] N82-13 MCGREGOR, I. Some BAE research on shielded and unshielded	Software considerations in the design of computer generated flight displays 82-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-13109 832-13109 832-13109 832-13109 832-13109 832-14780 832-14780 832-14780 832-14780 832-14780 832-14909 832-14909 832-14909 833-14909 8
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCFADDBH, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-120 MCFABLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-120 MCGILL, I. H. The protection of gas turbine blades - A platinum aluminide diffusion coating MS2-143 MCGLONE, M. E. Sensor failure detection system [NASA-CR-165515] N82-137 MCGIRGOR, I. Some BAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds	Software considerations in the design of computer generated flight displays 82-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-14742 832-13109 832-13109 832-13109 832-13109 832-13109 832-14780 832-14780 832-14780 832-14780 832-14780 832-14909 832-14909 832-14909 833-14909 8
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-126 MCPABLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-126 MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGIONE, H. B. Sensor failure detection system [NASA-CR-165515] N82-136 MCGREGOR, I. Some RAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds MCHALE, B. T. Chemistry of combustion of fuel-water mixtures	Software considerations in the design of computer generated flight displays 156 NIMURA, F. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TR-321T] N82-13109 HIRACLE, D. B. Study of the effects of maneuver compensation on beam pointing accuracy A82-14780 HOCHII, B. Extended time radar raw wideo recording A62-14909 HONTOYA, E. J. An advanced programmable/reconfigurable color graphics display system for crew station technology research [AIAM 81-2314] A82-13516 HORBILO, S. A. Have we overlooked the pilot's role in an automated flight deck [AIAM 81-2262] A82-13481 HORGAN, J. L. Effect of vacuum exhaust pressure on the
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCFADDRW, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-12C MCFARLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-12C MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLONE, M. E. Sensor failure detection system [NASA-CR-165515] N82-13C MCGREGOR, I. Some BAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds MCCHALR, B. T. Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12C	Software considerations in the design of computer generated flight displays 156 NIMURA, P. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TR-321T] N82-13109 HIRACLE, D. B. Study of the effects of maneuver compensation on beam pointing accuracy A82-14780 HOCHII, H. Extended time radar raw wideo recording A62-14909 A84-14780 A85-14780 A82-14780 A82-14909 A82-14909 A82-14909 A83-14909 A84-14909 A85-14909
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-126 MCPARLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-126 MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLONE, M. E. Sensor failure detection system [NASA-CR-165515] N82-136 MCGARGOR, I. Some BAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds MCHALE, E. T. Chemistry of combustion of fuel-water mixtures [AD-A105401] M82-126 MCKINLEY, J. B.	Software considerations in the design of computer generated flight displays 156 NIMURA, P. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TH-321T] N82-13109 NIRACLE, D. B. Study of the effects of maneuver compensation on beam pointing accuracy A82-14780 NOCHII, N. Extended time radar raw wideo recording A62-14909 A64 MONTOYA, B. J. An advanced programmable/reconfigurable color graphics display system for crew station technology research [AIAA 81-2314] A82-13516 NORELLO, S. A. Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] A82-13481 MORGAN, J. L. Effect of vacuum exhaust pressure on the performance of MHD ducts at high D-field [NASA-TM-82750] N82-13908
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-126 MCPABLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-126 MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGIONE, H. E. Sensor failure detection system [NASA-CR-165515] N82-136 MCGREGOR, I. Some RAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds MCHALE, E. T. Chemistry of combustion of fuel-water mixtures [AD-A105401] MCKINLEY, J. B. Analysis of integrated fuel-efficient, low-noise procedures in terminal-area operations	Software considerations in the design of computer generated flight displays 156 NIMURA, P. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TR-321T] N82-13109 HIRACLE, D. B. Study of the effects of maneuver compensation on beam pointing accuracy A82-14780 HOCHII, H. Extended time radar raw wideo recording A62-14909 A84-14780 A85-14780 A82-14780 A82-14909 A82-14909 A82-14909 A83-14909 A84-14909 A85-14909
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCFADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-12C MCFARLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-12C MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLONE, M. E. Sensor failure detection system [NASA-CR-165515] N82-13C MCGREGOR, I. Some RAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds N82-13C MCHALE, B. T. Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12C MCKIBLEY, J. B. Analysis of integrated fuel-efficient, low-noise procedures in terminal-area operations [DE81-029833]	Software considerations in the design of computer generated flight displays 156 NIMURA, P. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TH-321T] N82-13109 NIRACLE, D. B. Study of the effects of maneuver compensation on beam pointing accuracy A82-14780 MOCHII, M. Extended time radar raw wideo recording A62-14909 A64 MONTOIA, B. J. An advanced programmable/reconfigurable color graphics display system for crew station technology research [AIAA 81-2314] A82-13516 MORRILO, S. A. Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] A82-13481 MORGAN, J. L. Effect of vacuum exhaust pressure on the performance of MHD ducts at high D-field [NASA-TM-82750] N82-13908 MORRIS, P. B. Updated station deselection procedures to support automatic Omega receiver operation
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-126 MCPABLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-126 MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGILL, I. R. The protection of system [NASA-CR-165515] N82-136 MCGREGOR, I. Some RAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds MCHALE, B. T. Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-136 MCKINLEY, J. B. Analysis of integrated fuel-efficient, low-noise procedures in terminal-area operations [DE81-029833] MCHOHURTY, T. C.	Software considerations in the design of computer generated flight displays A82-14742 MIMURA, F. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TE-321T] N82-13109 MIRACLE, D. R. Study of the effects of maneuver compensation on beam pointing accuracy A82-14780 MOCHII, M. Extended time radar raw wideo recording A62-14909 A62-
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] MCPADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] MCPABLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLONE, H. E. Sensor failure detection system [NASA-CR-165515] MCGREGOR, I. Some BAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds MCHALE, B. T. Chemistry of combustion of fuel-water mixtures [AD-A105401] MCKINLBY, J. B. Analysis of integrated fuel-efficient, low-noise procedures in terminal-area operations [DE81-029833] MCCHORTRY, T. C. AD-1 oblique wing aircraft program	Software considerations in the design of computer generated flight displays 82-14742 8166 81HURA, F. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TR-321T] N82-13109 82-13109 82-13109 82-13109 82-13109 82-13109 82-13109 832-14780 832-14712 832-14712 832-14712 832-14712 832-14712 832-14712 832-14712 832-14712
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-126 MCPARLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-126 MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLOME, M. E. Sensor failure detection system [NASA-CR-165515] N82-137 MCGHEGOR, I. Some RAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds MCHALE, E. T. Chemistry of combustion of fuel-water mixtures [AD-A105401] MCKINLEY, J. B. Analysis of integrated fuel-efficient, low-noise procedures in terminal-area operations [DE81-029833] MCHOUTRY, T. C. AD-1 oblique wing aircraft program [AIAA PAPEE 81-2354] MCHARARA, W. G.	Software considerations in the design of computer generated flight displays 82-14742 8166 81HURA, F. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TR-321T] N82-13109 82-13109 82-13109 82-13109 82-13109 82-13109 82-13109 832-14780 832-14712 832-14712 832-14712 832-14712 832-14712 832-14712 832-14712 832-14712
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-126 MCPARLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-126 MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLONE, M. E. Sensor failure detection system [NASA-CR-165515] N82-136 MCGREGOR, I. Some RAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds MCHALE, E. T. Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-136 MCKINLEY, J. B. Analysis of integrated fuel-efficient, low-noise procedures in terminal-area operations [DE81-029833] MCHOHERY, T. C. AD-1 oblique wing aircraft program [AIAA PAPEE 81-2354] A82-143 MCHAHARA, W. G. P/A-18A high angle of attack/spin testing	Software considerations in the design of computer generated flight displays 156 156 156 156 157 156 156 157 158 158 159 159 150 150 150 150 150 150
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-126 MCPARLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-126 MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLONE, H. E. Sensor failure detection system [NASA-CR-165515] N82-136 MCGREGOR, I. Some RAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds MCHALE, B. T. Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-136 MCKINLRY, J. B. Analysis of integrated fuel-efficient, low-noise procedures in terminal-area operations [DE81-029833] N82-136 MCHODERRY, T. C. AD-1 oblique wing aircraft program [AIAA PAPEE 81-2354] A82-143 MCHAMARA, W. G. F/A-18A high angle of attack/spin testing	Software considerations in the design of computer generated flight displays 156 156 156 156 156 156 156 15
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-126 MCPARLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-126 MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLONE, H. E. Sensor failure detection system [NASA-CR-165515] N82-136 MCGREGOR, I. Some RAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds MCHALE, B. T. Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-136 MCKINLRY, J. B. Analysis of integrated fuel-efficient, low-noise procedures in terminal-area operations [DE81-029833] N82-136 MCHODERRY, T. C. AD-1 oblique wing aircraft program [AIAA PAPEE 81-2354] A82-143 MCHAMARA, W. G. F/A-18A high angle of attack/spin testing	Software considerations in the design of computer generated flight displays 82-14742 8166 81HURA, F. An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TR-321T] N82-13109 81RACLE, D. B. Study of the effects of maneuver compensation on beam pointing accuracy 862-14780 862-14780 862-14780 862-14909 864 864 865-14909 8664 8665 8666 8666 867-14909 8686-14909 8686-14909 869-1
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] MCPADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] MCPABLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLOME, M. E. Sensor failure detection system [NASA-CR-165515] MCGREGOR, I. Some RAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds MCHALE, E. T. Chemistry of combustion of fuel-water mixtures [AD-A105401] MCKINLBY, J. B. Analysis of integrated fuel-efficient, low-noise procedures in terminal-area operations [DE81-029833] MCHORTRY, T. C. AD-1 oblique wing aircraft program [AIAA PAPEE 81-2354] MCKHARRY, W. E. General purpose real-time interaction panel for digital simulation	Software considerations in the design of computer generated flight displays **NEWERA**, P.** An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TE-321T] N82-13109 **MIRACLE**, D.** Study of the effects of maneuver compensation on beam pointing accuracy **MOCHII**, B.** Extended time radar raw video recording **MONTOIA**, B.** An advanced programmable/reconfigurable color graphics display system for crew station technology research [AIAA 81-2314] A82-13516 **MORELLO**, S.** **MORELLO**
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCFADDRW, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-12C MCFARLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-12C MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLONE, B. E. Sensor failure detection system [NASA-CR-165515] N82-13C MCGREGOR, I. Some RAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds MCCHILL, J. B. Analysis of integrated fuel-efficient, low-noise procedures in terminal-area operations [DE81-029833] MCMURIRY, T. C. AD-1 oblique wing aircraft program [AIAA PAPEE 81-2354] A82-143 MCCHARARA, W. G. F/A-18A high angle of attack/spin testing MCCSHARRY, B. E. General purpose real-time interaction panel for digital simulation A82-144	Software considerations in the design of computer generated flight displays **NEWERA**, P.** An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-IR-321T] N82-13109 **MINACLE**, D.**, S.** Study of the effects of maneuver compensation on beam pointing accuracy **MOCHII**, H.** Extended time radar raw video recording **MOCHII**, B.** An advanced programmable/reconfigurable color graphics display system for crew station technology research [AIAA 81-2314] A82-13516 **MORELLO**, S.** **Aave we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] A82-13481 **MOREALD**, J.** **Beffect of vacuum exhaust pressure on the performance of MHD ducts at high D-field [NASA-Th-82750] NORRIS, P.** **B.** **Updated station deselection procedures to support automatic Omega receiver operation **A82-14712** **MOSS**, R.** **Tanker avionics and aircrew complement evaluation N82-13063 **MOTYKA**, P.** **Pault detection for two physically separated, communicating inertial measurement units **A82-13142** A failure detection and isolation system for tactical aircraft with separated inus
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] A82-134 MCPADDEN, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] N82-12C MCPARLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] N82-12C MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLONE, M. E. Sensor failure detection system [NASA-CR-165515] N82-13C MCGREGOR, I. Some RAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds MCHALE, E. T. Chemistry of combustion of fuel-water mixtures [AD-A105401] N82-12C MCKINLEY, J. B. Analysis of integrated fuel-efficient, low-noise procedures in terminal-area operations [DE81-029833] N82-13C MCHORTRY, T. C. AD-1 oblique wing aircraft program [AIAA PAPEE 81-2354] A82-143 MCHARRA, W. G. F/A-18A high angle of attack/spin testing MCSHARRY, M. E. General purpose real-time interaction panel for digital sigulation MEALY, G. L.	Software considerations in the design of computer generated flight displays **NEWERA**, F.** An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-TR-321T] N82-13109 **HIRACLE**, D.** Study of the effects of maneuver compensation on beam pointing accuracy **NEWERACLE**, D.** **AB2-14780** **BOCHII**, B.** Extended time radar raw video recording **BOCHII**, B.** Extended time radar raw video recording **AB2-14909** **MONTOYA**, B.** An advanced programmable/reconfigurable color graphics display system for crew station technology research [AIAA 81-2314] A82-13516 **MORELLO**, S.** **Have we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] A82-13481 **MORGAB**, J.** **Effect of vacuum exhaust pressure on the performance of MHD ducts at high D-field [NASA-TM-82750] N82-13908 **MORRIS**, P.** **Updated station deselection procedures to support automatic Omega receiver operation **A82-14712** **MOSS**, R.** **Tanker avionics and aircrew complement evaluation N82-13063 **MOTYKA**, P.** **Pault detection for two physically separated, communicating inertial measurement units **A82-13142** A failure detection and isolation system for tactical aircraft with separated IMUS **A82-14684**
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] MCPADDRM, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] MCPABLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGLOME, M. E. Sensor failure detection system [NASA-CR-165515] MCGREGOR, I. Some RAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds MCHALE, E. T. Chemistry of combustion of fuel-water mixtures [AD-A105401] MCKINLBY, J. B. Analysis of integrated fuel-efficient, low-noise procedures in terminal-area operations [DE81-029833] MCHORTRY, T. C. AD-1 oblique wing aircraft program [AIAA PAPEE 81-2354] MCKHARRY, W. E. General purpose real-time interaction panel for digital simulation	Software considerations in the design of computer generated flight displays **NEWERA**, P.** An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAL-IR-321T] N82-13109 **MINACLE**, D.**, S.** Study of the effects of maneuver compensation on beam pointing accuracy **MOCHII**, H.** Extended time radar raw video recording **MOCHII**, B.** An advanced programmable/reconfigurable color graphics display system for crew station technology research [AIAA 81-2314] A82-13516 **MORELLO**, S.** **Aave we overlooked the pilot's role in an automated flight deck [AIAA 81-2262] A82-13481 **MOREALD**, J.** **Beffect of vacuum exhaust pressure on the performance of MHD ducts at high D-field [NASA-Th-82750] NORRIS, P.** **B.** **Updated station deselection procedures to support automatic Omega receiver operation **A82-14712** **MOSS**, R.** **Tanker avionics and aircrew complement evaluation N82-13063 **MOTYKA**, P.** **Pault detection for two physically separated, communicating inertial measurement units **A82-13142** A failure detection and isolation system for tactical aircraft with separated inus
transport aircraft - The DC-9 Super 80 and beyon [AIAA 81-2218] MCPADDRN, P. D. Vibration test procedures for accessory angle drive gearboxes on Atar 09C engines [AD-A105269] MCPABLAND, R. H. MLS performance assessment, task 4. Volume 1: Evaluation procedures and equipment design [AD-A105393] MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion coating MCGILL, I. R. The protection of gas turbine blades - A platinum aluminide diffusion system [NASA-CR-165515] MCGBEGOR, I. Some MAE research on shielded and unshielded fuselage mounted air intakes at subsonic and supersonic speeds MCHALE, E. T. Chemistry of combustion of fuel-water mixtures [AD-A105401] MCKINLEY, J. B. Analysis of integrated fuel-efficient, low-noise procedures in terminal-area operations [DE81-029833] MCMORTRY, T. C. AD-1 oblique wing aircraft program [AIAA PAPEE 81-2354] MCCHARMARA, W. G. P/A-18A high angle of attack/spin testing MCCHARMARA, W. G. F/A-18A high angle of attack/spin testing MCCHARMARA, W. G. General purpose real-time interaction panel for digital simulation A82-146 MEALY, G. L. Application of multiple mcdel estimation	Software considerations in the design of computer generated flight displays **REMURA, F.** An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine [NAI-TR-321T] N82-13109 **REMICER, D. R.** Study of the effects of maneuver compensation on beam pointing accuracy **REMICER, D. R.** Study of the effects of maneuver compensation on beam pointing accuracy **REMICER, D. R.** **REMICER,

MUGGLI, W.	BORMAN, R. M.
The operational characteristics of turbojets, giving particular attention to the cooled	Acceptance testing of the Calspan variable
high-pressure turbine	stability Learjet A82-14937
A82-144	
MULLEY, W. G. The interface of multifunction controls and	An aerodynamic design and the overall stage performance of an air-cooled axial-flow turbine
displays to tomorrow's avionics	[NAL-TR-321T] N82-13109
[AIAA 81-2290] A82-134 Plat panel developments for future military aircra	
[AIAA 81-2302] A82-135	
Computergraphics for aircraft control [AIAA 81-2313] A82-135	[AIAA PAPER 81-2490] A82-13919
MONHIKSHA, B.	15 NOVOSARTOV, G. T. Optimization of requirements on the
Evaluation of an experimental technique to	pitting-prevention properties of turbojet-engine
investigate the effects of the engine position on engine/rylon/wing interference	oils A82-15723
N82-130	90 NUGENT, J.
MUNUKUTIA, S. S. Turbulent wake development behind streamlined bodi	Recent propulsion system flight tests at the NASA es Dryden Flight Research Center
N82-131	
MURPHY, W. J. Integrated Flight/Weapon Control design and	
evaluation	0
A82-147	
MUSICE, S. H. Evaluating sources of error in EAR/GEANS	Government testing [AIAA PAPEE 81-2443] A82-13877
navigation using a Kalman postprocessor	Progress report - CH-47 modernization program
MYRES, L. P.	39 A82-14930 OGI, S. K.
Becent propulsion system flight tests at the NASA	Advanced integrated CNI architectures
Dryden Plight Research Center [AIAA PAPER 81-2438] A82-138	74 OKEEPE, D. A82-14763
MYRONIK, D. J.	Status and tracking system for flight test data
Development and testing of dry chemicals in advanced extinguishing systems for jet engine	products [AIAA PAPER 81-2395] A82-14376
nacelle fires	[AIAA PAPER 81-2395] A82-14376 OPITTEE, B. W.
[NASA-CR-165011] N82-131	
MYSING, J. O. The influence of smart computers on the cockpit of	A82-14771 OPPIMITI, G.
the future	A multimicroprocessor system for ATCRBS monopulse
182-147	43 data processing A82-14777
N	ORNELAS, J. R.
N NAGEL, H.	
NAGEL, H. Comparison of different nozzle concepts for a	ORNELAS, J. R. Applications of head-up displays in commercial
BAGBL, H.	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft (AIAA 81-2300) A82-13506
NAGEL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130	OBNELAS, J. R. Applications of head-up displays in commercial transport aircraft (AIAA 81-2300) A82-13506
NAGEL, H. Comparison of different nozzle concepts for a reheated turbefan N82-130 NASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft [AIAA 81-2300] A82-13506 PANAGRAS, G. N. Himat aerodynamic design and flight test experience
NAGBL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130 NASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] A82-139	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft [AIAA 81-2300] PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience [AIAA PAPER 81-2433] A82-13871
NAGEL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130 NASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft (AIAA 81-2300) P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience [AIAA PAPER 81-2433] PARIMI, C. G.
MAGEL, H. Comparison of different nozzle concepts for a reheated turbefan MASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] MEEBE, P. C. Microprocessor flight control application study A82-147	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft [AIAA 81-2300] P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience [AIAA PAPER 81-2433] PARINI, C. G. Prediction and performance of radome-covered reflector antennas
MAGEL, H. Comparison of different nozzle concepts for a reheated turbefan N82-130 MASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBE, P. C. Microprocessor flight control application study	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft (AIAA 81-2300) P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience (AIAA PAPER 81-2433) PARIMI, C. G. Prediction and performance of radome-covered
MAGBL, H. Comparison of different nozzle concepts for a reheated turbefan N82-136 MASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPER 81-2368] NEEBE, P. C. Microprocessor flight control application study A82-147 NEGRIM, H. Comparison between the exact and an approximate feedback solution for medium range interception	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft [AIAA 81-2300] P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience [AIAA PAPER 81-2433] PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload
MAGBL, H. Comparison of different nozzle concepts for a reheated turbofan MASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] MEEBE, P. C. Microprocessor flight control application study A82-147 NEGRIW, H. Comparison between the exact and an approximate	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft (AIAA 81-2300) P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience (AIAA PAPER 81-2433) PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes
MAGBL, H. COMparison of different nozzle concepts for a reheated turbofan MASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] MEEBE, P. C. Microprocessor flight control application study A82-147 NEGRIW, H. Comparison between the exact and an approximate feedback solution for medium range interception problems MELSON, W. B., JR.	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft (AIAA 81-2300) P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience (AIAA PAPER 81-2433) A82-13871 PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, E.
NAGBL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130 NASH. J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBE, P. C. Microprocessor flight control application study A82-147 NEGRIM, M. Comparison between the exact and an approximate feedback sclution for medium range interception problems A82-131	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft (AIAA 81-2300) P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience (AIAA PAPER 81-2433) PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, E. Digital simulation of aircraft electrical
MAGBL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130 MASH. J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBB. P. C. Microprocessor flight control application study A82-147 NEGRIW. M. Comparison between the exact and an approximate feedback sclution for medium range interception problems A82-131 NELSON, W. E., JR. Microprocessor flight control application study A82-147	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft (AIAA 81-2300) P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience (AIAA PAPER 81-2433) PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-13871 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, E. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820
MAGBL, H. COMPATISON of different nozzle concepts for a reheated turbofan MASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] MEEBE, P. C. Microprocessor flight control application study A82-147 NEGRIW, H. Comparison between the exact and an approximate feedback solution for medium range interception problems A82-137 NELSON, W. B., JR. Microprocessor flight control application study A82-147 NEUMAN, P. Darboux points in Endume-fuel aircraft landing	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft (AIAA 81-2300) P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience (AIAA PAPER 81-2433) A82-13871 PARIMI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, E. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 PARKINSON, R. C. H.
MAGBL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130 MASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBE, P. C. Microprocessor flight control application study A82-147 NEGRIM, H. Comparison between the exact and an approximate feedback solution for medium range interception problems NELSON, W. B., JR. Microprocessor flight control application study A82-147 NEUMAN, P. parboux points in minimum-fuel aircraft landing problems A82-130	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft (AIAA 81-2300) P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience [AIAA PAPER 81-2433] PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, E. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 PARKINSON, R. C. H. An operational model of specific range for
MAGBL, H. COMPATISON of different nozzle concepts for a reheated turbofan N82-130 MASH. J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBB. P. C. Microprocessor flight control application study A82-147 NEGRIW, M. Comparison between the exact and an approximate feedback sclution for medium range interception problems A82-131 NELSON, W. E., JR. Microprocessor flight control application study A82-147 NEUMAN, P. Darboux points in Eldimum-fuel aircraft landing problems A82-130 NEUMANN, L.	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft (AIAA 81-2300) P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience (AIAA PAPER 81-2433) PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, B. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 PARKINSON, R. C. H. An operational model of specific range for microprocessor applications in piston-prop general aviation airplanes
MAGBL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130 MASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBE, P. C. Microprocessor flight control application study A82-147 NEGRIM, H. Comparison between the exact and an approximate feedback solution for medium range interception problems NELSON, W. B., JR. Microprocessor flight control application study A82-147 NEUMAN, P. parboux points in minimum-fuel aircraft landing problems A82-130	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft [AIAA 81-2300] P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience [AIAA PAPER 81-2433] PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, B. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 PARKINSON, R. C. H. An operational model of specific range for microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] A82-13526
NAGBL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130 NASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBE, F. C. Microprocessor flight control application study A82-147 NEGRIM, H. Comparison between the exact and an approximate feedback sclution for medium range interception problems A82-137 NELSON, W. B., JR. Microprocessor flight control application study A82-147 NEUMAN, F. parboux points in minimum-fuel aircraft landing problems A82-147 NEUMANN, L. A synthesis technique for highly uncertain and interacting multivariable flight control systems A82-148	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft (AIAA 81-2300) P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience (AIAA PAPER 81-2433) PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, E. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 PARKINSON, R. C. H. An operational model of specific range for microprocessor applications in piston-prop general aviation airplanes (AIAA 81-2330) PARRISH, L. E. Navy spin evaluation of the A-7 airplane
NAGBL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130 NASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBE, F. C. Microprocessor flight control application study A82-147 NEGRIM, M. Comparison between the exact and an approximate feedback solution for medium range interception problems A82-130 NELSON, W. B., JR. Microprocessor flight control application study A82-147 NEUMAN, F. Darboux points in minimum-fuel aircraft landing problems A82-130 NEUMANN, L. A synthesis technique for highly uncertain and interacting multivariable flight control systems	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft [AIAA 81-2300] P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience [AIAA PAPER 81-2433] PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, E. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 PARKINSON, R. C. H. An operational model of specific range for microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] PARRISH, L. B.
MAGBL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130 MASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPER 81-2368] NEEBE, P. C. Microprocessor flight control application study A82-147 NEGRIM, H. Comparison between the exact and an approximate feedback solution for medium range interception problems NELSON, W. B., JR. Microprocessor flight control application study A82-147 NEUMAN, P. parboux points in minimum-fuel aircraft landing problems A82-130 NEUMANN, L. A synthesis technique for highly uncertain and interacting multivariable flight control systems A82-146 MGUYEM, L. T. Flight test experience with high-alpha control system techniques on the F-14 airplane	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft (AIAA 81-2300) P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience [AIAA PAPER 81-2433] PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, E. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 PARKINSON, R. C. H. An operational model of specific range for microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] PARRISH, L. E. Navy spin evaluation of the A-7 airplane configured with automatic maneuvering flaps A82-14933 PASSHORE, H.
NAGBL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130 NASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBE, F. C. Microprocessor flight control application study A82-147 NEGRIW, H. Comparison between the exact and an approximate feedback solution for medium range interception problems NELSON, W. B., JR. Microprocessor flight control application study A82-147 NEUMAN, F. parboux points in minimum-fuel aircraft landing problems A82-146 NEUMANN, L. A synthesis technique for highly uncertain and interacting multivariable flight control systems A82-146 NEGUYEN, L. T. Plight test experience with high-alpha control system techniques on the F-14 airplane [AIAA PAPEE 81-2505] NIKOLITSCH, D.	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft (AIAA 81-2300) P PANAGEAS, G. N. HIMAT aerodynamic design and flight test experience (AIAA PAPER 81-2433) PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, E. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 PARKINSON, E. C. H. An operational model of specific range for microprocessor applications in piston-prop general aviation airplanes (AIAA 81-2330) PARRISH, L. B. Navy spin evaluation of the A-7 airplane configured with automatic maneuvering flaps A82-14933 PASSMORE, H. Avionics implications from weapon system
NAGBL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130 NASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBE, F. C. Microprocessor flight control application study A82-147 NEGRIW, M. Comparison between the exact and an approximate feedback solution for medium range interception problems A82-130 NELSON, W. B., JR. Microprocessor flight control application study A82-147 NEUMAN, F. Darboux points in minimum-fuel aircraft landing problems A82-130 NEUMANN, L. A synthesis technique for highly uncertain and interacting multivariable flight control systems A82-146 NEGUYEN, L. T. Flight test experience with high-alpha control system techniques on the F-14 airplane [AIAA PAPEE 81-2505] NEKOLITSCH, D. A calculation method for slender wing-body	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft [AIAA 81-2300] PANAGEAS, G. B. HiMAT aerodynamic design and flight test experience [AIAA PAPER 81-2433] PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, B. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 PARKINSON, E. C. H. An operational model of specific range for microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] PARRISE, L. E. Navy spin evaluation of the A-7 airplane configured with automatic maneuvering flaps A82-14933 PASSMORE, H. Avionics implications from weapon system operational utility studies on Manned Air Combat Simulators
NAGBL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130 NASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBE, F. C. Microprocessor flight control application study A82-147 NEGRIW, H. Comparison between the exact and an approximate feedback solution for medium range interception problems NELSON, W. B., JR. Microprocessor flight control application study A82-147 NEUMAN, F. parboux points in minimum-fuel aircraft landing problems A82-146 NEUMANN, L. A synthesis technique for highly uncertain and interacting multivariable flight control systems A82-146 NEGUYEN, L. T. Plight test experience with high-alpha control system techniques on the F-14 airplane [AIAA PAPEE 81-2505] NIKOLITSCH, D.	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft [AIAA 81-2300] P PANAGEAS, G. B. HiMAT aerodynamic design and flight test experience [AIAA PAPER 81-2433] PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, R. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 PARKINSON, R. C. H. An operational model of specific range for microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] PARRISS, L. B. Navy spin evaluation of the A-7 airplane configured with automatic maneuvering flaps A82-14933 PASSMORE, H. Avionics implications from weapon system operational utility studies on Manned Air Combat Simulators [AIAA 81-2230] A82-13463
MAGBL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130 MASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBE, F. C. Microprocessor flight control application study A82-147 NEGRIW, H. Comparison between the exact and an approximate feedback solution for medium range interception problems NELSON, W. E., JR. Microprocessor flight control application study A82-147 NEUMAN, F. Darboux points in minimum-fuel aircraft landing problems A82-146 NEUMANN, L. A synthesis technique for highly uncertain and interacting multivariable flight control systems A82-146 MGUYEN, L. T. Plight test experience with high-alpha control system techniques on the F-14 airplane [AIAA PAPEE 81-2505] NIKOLITSCH, D. A calculation method for slender wing-body configurations in supersonic flow at high angles of attack [BMVG-FBWT-79-15]	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft [AIAA 81-2300] P PANAGEAS, G. H. HiMAT aerodynamic design and flight test experience [AIAA PAPER 81-2433] PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, R. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 PARKINSON, R. C. H. An operational model of specific range for microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] PARRIES, L. B. Navy spin evaluation of the A-7 airplane configured with automatic maneuvering flaps PASSMORE, H. Avionics implications from weapon system operational utility studies on Manned Air Combat Simulators [AIAA 81-2230] PATRICK, W. P. Impedance modeling of acoustic absorbing materials
MAGBL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130 MASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBE, F. C. Microprocessor flight control application study A82-147 NEGRIN, H. Comparison between the exact and an approximate feedback solution for medium range interception problems NELSON, W. B., JR. Microprocessor flight control application study A82-147 NEUMAN, F. Darboux points in minimum-fuel aircraft landing problems A82-130 NEUMANN, L. A synthesis technique for highly uncertain and interacting multivariable flight control systems A82-146 BGUYEN, L. T. Flight test experience with high-alpha control system techniques on the F-14 airplane [AIAA PAPEE 81-2505] NEOLITSCH, D. A calculation method for slender wing-body configurations in supersonic flow at high angles of attack [BMYG-FBWT-79-15] NE2-130 NE2-131	ORNELAS, J. R. Applications of head-up displays in commercial transport aircraft [AIAA 81-2300] P PANAGEAS, G. H. HiMAT aerodynamic design and flight test experience [AIAA PAPER 81-2433] PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, E. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 PARKINSON, R. C. H. An operational model of specific range for microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] PARRISH, L. B. Navy spin evaluation of the A-7 airplane configured with automatic maneuvering flaps PASSHORE, H. Avionics implications from weapon system operational utility studies on Manned Air Combat Simulators [AIAA 81-2230] PATRICK, W. P. Impedance modeling of acoustic absorbing materials for aircraft engine applications
NAGBL, H. COMPATISON Of different nozzle concepts for a reheated turbofan N82-130 NASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBE, F. C. Microprocessor flight control application study A82-147 NEGRIW, H. Comparison between the exact and an approximate feedback solution for medium range interception problems NELSON, W. B., JR. Microprocessor flight control application study A82-147 NEUMAN, F. parboux points in minimum-fuel aircraft landing problems A82-146 NEUMANN, L. A synthesis technique for highly uncertain and interacting multivariable flight control systems A82-146 NEUWEN, L. T. Plight test experience with high-alpha control system techniques on the F-14 airplane [AIAA PAPEE 81-2505] NIKOLITSCH, D. A calculation method for slender wing-body configurations in supersonic flow at high angles of attack [BMVG-FBWT-79-15] NE2-136 NEPPERSS, K. R. Performance estimation from non-steady manoeuvres [AIAA PAPEE 81-2424] A82-136	ORNELAS, J. B. Applications of head-up displays in commercial transport aircraft [AIAA 81-2300] P PANAGEAS, G. B. HiMAT aerodynamic design and flight test experience [AIAA PAPER 81-2433] PARINI, C. G. Prediction and performance of radome-covered reflector antennas PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, B. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 PARKINSON, B. C. H. An operational model of specific range for microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] PARRISS, L. B. Navy spin evaluation of the A-7 airplane configured with automatic maneuvering flaps A82-14933 PASSMOER, H. Avionics implications from weapon system operational utility studies on Manned Air Combat Simulators [AIAA 81-2230] PATEICK, W. P. Impedance modeling of acoustic absorbing materials for aircraft engine applications A82-14043 PAUL, B. B.
MAGBL, H. Comparison of different nozzle concepts for a reheated turbofan N82-130 MASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBE, F. C. Microprocessor flight control application study A82-147 NEGRIM, M. Comparison between the exact and an approximate feedback solution for medium range interception problems NELSON, W. B., JR. Microprocessor flight control application study A82-147 NEUMAN, F. Darboux points in minimum-fuel aircraft landing problems A82-130 NEUMANN, L. A synthesis technique for highly uncertain and interacting multivariable flight control systems A82-146 EGUYEN, L. T. Flight test experience with high-alpha control system techniques on the F-14 airplane [AIAA PAPEE 81-2505] NIKOLITSCH, D. A calculation method for slender wing-body configurations in supersonic flow at high angles of attack [BMVG-PBWT-79-15] NIPPEESS, K. E. Performance estimation from non-steady manoeuvres [AIAA PAPEE 81-2424] NOBLE, W. B.	ORNBLAS, J. B. Applications of head-up displays in commercial transport aircraft (AIAA 81-2300] PANAGEAS, G. H. HiMAT aerodynamic design and flight test experience (AIAA PAPER 81-2433] PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, B. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 PARKINSON, R. C. H. An operational model of specific range for microprocessor applications in piston-prop general aviation airplanes (AIAA 81-2330) PARRISSH, L. B. Navy spin evaluation of the A-7 airplane configured with automatic maneuvering flaps A82-14933 PASSHOER, H. Avionics implications from weapon system operational utility studies on Manned Air Combat Simulators (AIAA 81-2230) A82-13463 PATRICK, W. P. Impedance modeling of acoustic absorbing materials for aircraft engine applications A82-14043 PAUL, B. E. A ballistic design model for initiators for
NAGBL, H. COMPATISON Of different nozzle concepts for a reheated turbofan N82-130 NASH, J. S. The Advanced Range Instrumentation Aircraft improvement and modernization program [AIAA PAPEE 81-2368] NEEBE, F. C. Microprocessor flight control application study A82-147 NEGRIW, H. Comparison between the exact and an approximate feedback solution for medium range interception problems NELSON, W. B., JR. Microprocessor flight control application study A82-147 NEUMAN, F. parboux points in minimum-fuel aircraft landing problems A82-146 NEUMANN, L. A synthesis technique for highly uncertain and interacting multivariable flight control systems A82-146 NEUWEN, L. T. Plight test experience with high-alpha control system techniques on the F-14 airplane [AIAA PAPEE 81-2505] NIKOLITSCH, D. A calculation method for slender wing-body configurations in supersonic flow at high angles of attack [BMVG-FBWT-79-15] NE2-136 NEPPERSS, K. R. Performance estimation from non-steady manoeuvres [AIAA PAPEE 81-2424] A82-136	ORNELAS, J. E. Applications of head-up displays in commercial transport aircraft [AIAA 81-2300] PANAGEAS, G. B. HiMAT aerodynamic design and flight test experience [AIAA PAPER 81-2433] PARINI, C. G. Prediction and performance of radome-covered reflector antennas A82-15311 PARK, G. D. Determining hinge moments and empennage airload parameters from flight data for Learjet airplanes A82-13120 PARKER, E. Digital simulation of aircraft electrical generating system by means of Sceptre program A82-14820 PARKINSON, E. C. B. An operational model of specific range for microprocessor applications in piston-prop general aviation airplanes [AIAA 81-2330] PARRISH, L. B. Avy spin evaluation of the A-7 airplane configured with automatic maneuvering flaps A82-14933 PASSORE, H. Avionics implications from weapon system operational utility studies on Manned Air Combat Simulators [AIAA 81-2230] A82-13463 PATRICK, W. P. Inpedance modeling of acoustic absorbing materials for aircraft engine applications A82-14944 PAUL, B. E. A ballistic design model for initiators for aircraft personnel escape systems

PERSONAL AUTHOR INDEX

PAVLIE, T. A. Tosting of the SIU-5A exection seat for the	P/A-10	POTENZA, J.	
Testing of the SJU-5A ejection seat for the /HOENET/ aircraft		Inverse SAR and its application to aircraft classification	
	A82-14955		A82-14871
	ign A82-13128	POTTS, D. W. Direct digital design method for reconfigur multivariable control laws for the A-7D D	
PEDDERW, K. H. A look inside the Langley 16-foot transonic	:	II aircraft	A82-14828
tunnel: User's guide [NASA-TM-83186] PERALA, B. A.	N82-12085	PRICE, B. A., JR. An investigation of P-16 nozzle-afterbody f at transonic Mach numbers with emphasis of	
Assessment methodology of the lightning thr advanced aircraft	eat to	scale effects [AD-A104905]	N82-12392
PERDUB, B. H.	A82-14759	PRICE, J. Applications of covariance analysis simulat	ion to
High speed microwave phase-locked loops	100 4500	avionics flight testing	
PERIN, R.	A82-14696		A82-14767
Wind tunnel tests of powered models: A com of two methods of simulating the jets of		PRIEST, A. J. Some RAE research on shielded and unshielde fuselage mounted air intakes at subsonic	
engines	N82-13087	supersonic speeds	N82-13068
PERRIER, P.		PUGH, G.	
An acquisition and analysis system for dyna tests of air inlets	IB1C	Establishment of an experimental technique provide accurate measurement of the insta	
PERSON, L. H. Have we overlooked the pilot's role in an	N82-13082	drag of close coupled civil nacelle/airfr configurations, using a full span model w turbine powered engine simulators	ame
automated flight deck		•	N82-13089
[AIAA 81-2262] PERSON, L. H., JR.	A82-13481	PUBTELL, J. H. Light Airborne Hulti-Purpose System	
The integration of control and display conc	epts		∆82-13244
	A82-13972	PUSKAS, E. Automatic parachute releasers for premedita	ted
PBTERSEN, K. L. Flight experience with a remotely augmented vehicle flight test technique	l	parachuting	A82-14960
[AIAA PAPER 81-2417] PETERSOS, A. A.	A82-13857	R	
Helicopter icing		BAABE, P.	
PETROPSKY, S. H.	A82-13243	German-Argentine experiment: Vertical-roto engine	r wind
Digital avionics display processor		-	N82-12648
[AIAA 81-2311] PHEENY, H.	A82-13513	BACKAOSKAS, B. Electro-optical vector scoring system	
'Little people' problem /MA-2 torso barness		[AIAA PAPER 81-2373]	A82-13945
PHELPS, B. L.	A82-14958	RACKLEY, L. B. A system safety program for aircraft produc	tion
In-service inspection methods for graphite- structures on commercial transport aircra		and deployment	A82-14983
[NASA-CR-165746]	N82-12142	RAJALA, S. A.	
PHIPPS, W. D. MLS performance assessment, task 4. Volume	. 1:	An advanced programmable/reconfigurable col graphics display system for crew station	.or
Evaluation procedures and equipment design	מו	technology research	
[AD-A105393] PIRRI, F.	N82-12061	[AIAA 81-2314] RAKIB, D. A.	A82-13516
A multimicroprocessor system for AICEBS mon	opulse	Pleet Flight Loads Survey monitoring and an	alysis
data processing	A82-14777	techniques [AIAA PAPER 81-2461]	A82-13903
PLUMBE, J. A. Investigation of severe lightning strike in		BATTAN, K. S.	
to two USAF P-106A aircraft	cidents	Digital redesign of existing multiloop cont control systems	
[NASA-CR-165794] PLUMBER, C. A.	N82-12052	READER, D. C.	A82-13093
AV-88 technical update - Leading edge root extension development		A new safety barness for mobile aircrew	A82-14963
PO-CHEDLEY, D. A.	A82-14940	REBBECHI, B. A vapour cycle cabin cooling system for the	. Cea
Aircraft alerting systems standardization s		King MK.50 helicopter	
[AIAA 81-2242] POLHAHUS, B. C.	A82-13468	[AD-A105211] BEED, W. H., III	N82-12069
The development of cryogenic wind tunnels a their application to maneuvering aircraft		Aeroelasticity matters - Some reflections of decades of testing in the NASA Langley Tr	
technology	A82-13971	Dynamics Tunnel	A82-13969
POLI, C. A multimicroprocessor system for AICRBS mon	opulse	Aeroelasticity matters: Some reflections of decades of testing in the NASA Langley tr	
data processing	A82-14777	dynamics tunnel [HASA-TM-83210]	N82-12041
POOL, A.		REEPS, S. H.	
Practical aspects of instrumentation system installation, volume 13	l	Evaluation of a selected group of anti-expo	
		datment confidurations for their effects	on the
PORTER, B.	N82-13140	garment configurations for their effects operational performance and survival of Naircrewmen	

A82-14829

REGISTER, H. I.		ROWE, S. A.	
Collection and simulation of spatial infrar	ed	Electromechanical actuation development pro	
signatures of military jet aircraft	190-13021		A82-14705
[AIAA PAPEE 81-2494] BEILLY, B. A.	A82-13921	RUBIN, J. Distributed Time Division Multiple Access /	DTDMA/
New advances in signal processing technolog	y for	 A distributed signaling technique for a 	
integrated CNI avionics	A82-14762	tactical communications	A82-14719
REUTER, J. D.	802-14702	RUDDELL, A. J.	
Development of a lifting parachute to provi		Advancing blade concept /ABC/ development t	est
self-dispersing capability for an Avco-de tactical munition	esigned	program [AIAA PAPER 81-2437]	A82-13873
	A82-13962	BUDHITSKI, D. B.	
REZEIK, B. G.		Compressor stall inducing installation effe	
Study of the load-carrying capacity of avia gas-turbine engine impellers under low-cy		an engine control parameter for the CF-5	N82-13085
loading at normal and high temperatures		RUSSELL, G. F.	
RHODY, B.	A 82-15482	Digital detection and processing of laser be signals for aircraft collision bazard war	
A VHF homing system with VHF radiotelephony	for		A82-13525
area-representative strip-survey flights		BUTISHAUSER, H. J.	n a a d
conducted, as part of combined forest inventories, with light aircraft carrying	. 70 mm	Experimental and analytical studies of adva air cushion landing systems	nceu
and 35 mm cameras		[NASA-CR-3476]	N82-12065
RICHARDS. L. C.	A82-15748	RYAN, G. R., JR. Recent improvements at the Naval Air Test C	enter
Transportation systems evaluation methodolo	γp	for increased test system flexibility	encer
development and applications, phase 3		[AIAA PAPER 81-2392]	A82-13888
[NASA-CR-164999] RIDDLE, D. W.	N82-12051		
Powered-lift takeoff performance characteri	stics	S	
determined from flight test of the Quiet		SACES, G. Effects of aerodynamic coupling on the dyna	mias of
Short-haul Research Aircraft /QSBA/ [AIAA PAPER 81-2409]	A82-13852	roll aircraft	wics of
Powered-lift STOL aircraft shipboard operat	lons -		N82-12070
A comparison of simulation, land-based an trial results for the QSRA	id sea	SAHH, P. B. 'In situ' composites for jet propulsion and	
	A82-13938	stationary gas turbine applications	
RINGEL, M. B.	DDE		A82-15824
Detection range analysis of an airborne med radar	ILUM PAP	SAIN, H. K. An approach to robust nonlinear control des	ign
	A82-14723		A82-13128
Prediction and performance of radome-covered	.A	SAINT SAUVER, C. L. Advanced fighter technology integration AFT	I/F-16
reflector antennas	·u	test program overview	-,
	A82-15311		A82-14398
ROBERTS, D. W. Prediction of subsonic aircraft flows with	iet	SALTEMAN, B. J. A review of flight-to-wind tunnel drag corr	elation
exhaust interactions	-	[AIAA PAPER 81-2475]	A82-14382
ROBERTS, E. O.	N82-13096	SANDER, D. L. Algorithms for an adaptive dynamic window 1	n
Performance assessment of the ACES-II eject	101	electronic map systems	
seat-A-10 configuration	192-1/1990	SANDERSON, R. C.	A82-14769
ROBERTSON, J. B.	A02-14300	Practical aspects of instrumentation system	
Experimental evaluation of a perspective to	nnel	installation, volume 13	N82-13140
display for three-dimensional helicopter approaches		[NASA-TH-84067] SANTAMARIA, L. J.	MO2-13140
	A82-15847	Evaluation of a selected group of anti-expo	
ROBINETTE, G. J. Strapdown inertial reference systems perform	- manao	garment configurations for their effects	on the
		operational performance and survival of N	
analysis	. шапсе	operational performance and survival of Naircrewmen	
analysis	A82-14682	aircrewmen	
analysis ROCK, S. H.		aircrewmen SAWYER, W. C.	a v al
analysis ROCK, S. M. Sensor farlure detection system [NASA-CR-165515]		aircrewmen SAWYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a	aval A82-14972
analysis ROCK, S. M. Sensor faulure detection system [NASA-CR-165515] ROEHRLE, H.	A82-14682 N82-13145	aircrewmen SAWYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and	aval A82-14972
analysis ROCK, S. M. Sensor farlure detection system [NASA-CR-165515]	A82-14682 N82-13145	aircrewmen SAWYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a	aval A82-14972
analysis ROCK, S. M. Sensor farlure detection system [NASA-CR-165515] ROBHRLE, H. Structural dynamics; Modified calculations [BMYG-PBWT-81-1] ROOBEY, R. H.	A82-14682 N82-13145 N82-13457	aircrewmen SAWYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and Volume 1: Trapezoidal tail [NASA-TH-80097] SCHACHTER, B. J.	aval A82-14972 3.70- N82-13110
analysis BOCK, S. H. Sensor farlure detection system [NASA-CR-165515] BOEHBLE, H. Structural dynamics; Modified calculation: [BMVG-FBWT-81-1]	A82-14682 N82-13145 N82-13457	aircrewmen SAWYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and Volume 1: Trapezoidal tail [NASA-TM-80097]	aval A82-14972 3.70. N82-13110
analysis ROCK, S. H. Sensor farlure detection system [NASA-CR-165515] ROEBRLE, H. Structural dynamics; Modified calculation: [BMYG-PBWT-81-1] ROOMEY, R. H. The use of observers on relaxed static stall aircraft	A82-14682 N82-13145 N82-13457	aircrewmen SAWYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and Volume 1: Trapezoidal tail [NASA-TM-80097] SCHACHTER, B. J. Computer image generation for flight simulated as a computer of the compu	aval A82-14972 3.70. N82-13110
analysis ROCK, S. M. Sensor farlure detection system [NASA-CR-165515] ROEHRLE, H. Structural dynamics: Modified calculation: [BMVG-FBWT-81-1] ROOMEY, R. H. The use of observers on relaxed static stal aircraft Enhanced aircraft handling qualities by	A82-14682 N82-13145 S N82-13457 Dillty	aircrewmen SAWYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and Volume 1: Trapezoidal tail [NASA-TH-80097] SCHACHTER, B. J. Computer image generation for flight simulated and the computer of the Calspan variable acceptance testing of the Calspan variable	aval A82-14972 3.70. N82-13110
analysis BOCK, S. M. Sensor farlure detection system [NASA-CR-165515] BOEHRLE, H. Structural dynamics: Modified calculation: [BMVG-PBWT-81-1] BOONEY, R. H. The use of observers on relaxed static stal aircraft Enhanced aircraft handling qualities by longitudinal dynamics mode decoupling	A82-14682 N82-13145 S N82-13457 Dillty	aircrewmen SAWYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and Volume 1: Trapezoidal tail [NASA-TM-80097] SCHACHTER, B. J. Computer image generation for flight simulated as a computer of the compu	aval A82-14972 3.70. N82-13110
analysis BOCK, S. H. Sensor farlure detection system [NASA-CR-165515] ROBERLE, H. Structural dynamics: Modified calculation: [BMYG-PBWT-81-1] ROOMEY, E. H. The use of observers on relaxed static stall aircraft Enhanced aircraft handling qualities by longitudinal dynamics mode decoupling ROSCOB, S. J.	A82-14682 N82-13145 S N82-13457 Dility A82-14740	Aircrewmen SANYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and Volume 1: Trapezoidal tail [NASA-TH-80097] SCHACHTER, B. J. Computer image generation for flight simulated stability learjet SCHILT2, B. J., JR.	aval A82-14972 3.70. N82-13110 tion A82-15599 A82-14937
analysis BOCK, S. M. Sensor farlure detection system [NASA-CR-165515] BOEHRLE, H. Structural dynamics: Modified calculation: [BMVG-PBWT-81-1] BOONEY, R. H. The use of observers on relaxed static stal aircraft Enhanced aircraft handling qualities by longitudinal dynamics mode decoupling	A82-14682 N82-13145 S N82-13457 Dility A82-14740	aircrewmen SAWYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and Volume 1: Trapezoidal tail [NASA-TM-80097] SCHACHTER, B. J. Computer image generation for flight simula SCHELHORE, A. E. Acceptance testing of the Calspan variable stability Learjet	aval A82-14972 3.70. N82-13110 tion A82-15599 A82-14937
analysis BOCK, S. H. Sensor farlure detection system [NASA-CR-165515] BOEHRLE, H. Structural dynamics; Modified calculation: [BMYG-PBWT-81-1] BOOMEY, B. H. The use of observers on relaxed static stall aircraft Enhanced aircraft handling qualities by longitudinal dynamics mode decoupling BOSCOB, S. M. Computer-animated predictive displays for microwave landing approaches	A82-14682 N82-13145 S N82-13457 Dility A82-14740	Aircrewmen SAWYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and Volume 1: Trapezoidal tail [NASA-TM-80097] SCHACHTER, B. J. Computer image generation for flight simula SCHELHORE, A. E. Acceptance testing of the Calspan variable stability learjet SCHILT2, B. J., JR. Investigation of the structural degradation personnel hazards resulting from helicopt composite structures exposed to fires and	aval A82-14972 3.70. M82-13110 tion A82-15599 A82-14937
analysis BOCK, S. M. Sensor farlure detection system [NASA-CR-165515] ROBHRLE, H. Structural dynamics: Modified calculation: [BMYG-PBWT-81-1] ROOBEY, E. H. The use of observers on relaxed static state aircraft Enhanced aircraft handling qualities by longitudinal dynamics mode decoupling ROSCOE, S. B. Computer-animated predictive displays for microwave landing approaches ROSS, J. A.	A82-14682 N82-13145 S N82-13457 Dility A82-14740 A82-14826 A82-15816	Aircrewmen SANYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and Volume 1: Trapezoidal tail [NASA-TH-80097] SCHACHTER, B. J. Computer image generation for flight simulated stability learjet SCHILT2, B. J., JR. Investigation of the structural degradation personnel hazards resulting from helicopt composite structures exposed to fires and explosions	aval A82-14972 3.70. M82-13110 tion A82-15599 A82-14937
analysis BOCK, S. M. Sensor fallure detection system [NASA-CR-165515] BOEHRLE, B. Structural dynamics: Modified calculation: [BMYG-PBWT-81-1] BOONEY, B. H. The use of observers on relaxed static stal aircraft Enhanced aircraft handling qualities by longitudinal dynamics mode decoupling BOSCOB, S. M. Computer-animated predictive displays for microwave landing approaches BOSS, J. A. Some BAE research on shielded and unshield fuselage mounted air intakes at subsonic	A82-14682 N82-13145 N82-13457 Dility A82-14740 A82-14826 A82-15816	aircrewmen SAWYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and Volume 1: Trapezoidal tail [NASA-TM-80097] SCHACHTER, B. J. Computer image generation for flight simula SCHELHORM, A. E. Acceptance testing of the Calspan variable stability learjet SCHILTZ, R. J., JR. Investigation of the structural degradation personnel hazards resulting from helicopt composite structures exposed to fires and explosions [AD-A104757] SCHIEGEL, B. O.	aval A82-14972 3.70- N82-13110 tion A82-15599 A82-14937 and er /or
analysis ROCK, S. M. Sensor failure detection system [NASA-CR-165515] ROEHRLE, H. Structural dynamics: Modified calculation: [BMYG-FBWT-81-1] ROOMEY, R. H. The use of observers on relaxed static stataircraft Enhanced aircraft handling qualities by longitudinal dynamics mode decoupling ROSCOB, S. M. Computer-animated predictive displays for microwave landing approaches ROSS, J. A. Some RAE research on shielded and unshield.	A82-14682 B82-13145 S N82-13457 Dility A82-14740 A82-14826 A82-15816 ed and	Aircrewmen SAWYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and Volume 1: Trapezoidal tail [NASA-TM-80097] SCHACHTER, B. J. Computer image generation for flight simula SCHELHORE, A. E. Acceptance testing of the Calspan variable stability Learjet SCHILT2, B. J., JR. Investigation of the structural degradation personnel hazards resulting from helicopt composite structures exposed to fires and explosions [AD-A104757] SCHILEGEL, M. O. The Cessna T303 Crusader	aval A82-14972 3.70- N82-13110 tlon A82-15599 A82-14937 and er /or
analysis BOCK, S. M. Sensor fallure detection system [NASA-CR-165515] BOEHRLE, B. Structural dynamics: Modified calculation: [BMYG-PBWT-81-1] BOONRY, R. H. The use of observers on relaxed static stal aircraft Enhanced aircraft handling qualities by longitudinal dynamics mode decoupling BOSCOR, S. M. Computer-animated predictive displays for microwave landing approaches BOSS, J. A. Some BAE research on shielded and unshield fuselage mounted air intakes at subsonic supersonic speeds BOTE, S. P.	A82-14682 N82-13145 N82-13457 Dility A82-14740 A82-14826 A82-15816 ed and N82-13068	aircrewmen SAWYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and Volume 1: Trapezoidal tail [NASA-TM-80097] SCHACHTER, B. J. Computer image generation for flight simula SCHELBORM, A. E. Acceptance testing of the Calspan variable stability learjet SCHILTZ, B. J., JR. Investigation of the structural degradation personnel hazards resulting from helicopt composite structures exposed to fires and explosions [AD-A104757] SCHLEGEL, M. O. The Cessna T303 Crusader [AIAA PAPER 81-2440] SCHLEGEL, R. G.	aval A82-14972 3.70. N82-13110 tion A82-15599 A82-14937 and er /or N82-12057 A82-13876
analysis BOCK, S. M. Sensor farlure detection system [NASA-CR-165515] ROBHRLE, H. Structural dynamics: Modified calculation: [BMYG-PBWT-81-1] ROOBEY, B. H. The use of observers on relaxed static state aircraft Enhanced aircraft handling qualities by longitudinal dynamics mode decoupling ROSCOE, S. B. Computer-animated predictive displays for microwave landing approaches ROSS, J. A. Some RAE research on shielded and unshielder fuselage mounted air intakes at subsonic supersonic speeds	A82-14682 N82-13145 N82-13457 Dility A82-14740 A82-14826 A82-15816 ed and N82-13068	Aircrewmen SAWYER, W. C. Pressure distributions on three different cruciform aft-tail control surfaces of a wingless missile at Mach 1.60, 2.36, and Volume 1: Trapezoidal tail [NASA-TH-80097] SCHACHTER, B. J. Computer image generation for flight simulated stability learjet SCHILT2, R. J., JR. Investigation of the structural degradation personnel hazards resulting from helicopt composite structures exposed to fires and explosions [AD-A104757] SCHLEGEL, M. O. The Cessna T303 Crusader [AIAA PAPER 81-2440]	aval A82-14972 3.70. N82-13110 tion A82-15599 A82-14937 and er /or N82-12057 A82-13876

SCHAIDT, D. K.		SIGALLA, A.	
Interactive aircraft flight control and		Airframe-propulsion system aerodynamic	
aeroelastic stabilization [NASA-CR-165036]	N82-13150	interference predictions at high transon: numbers including off-design engine airf.	
SCHNEIDER, E.	BUZ 13130	effects	
The load-carrying behavior of a trapezoida	1		N82-13098
aluminum-alloy supporting element, subje		SILVIOUS, C.	
a compressive stress, in the postbucklin		Wire strike protection	
CCUNDINDD D D	A82-14418	CTM A C	A82-13246
SCHNEIDER, P. W. Effect of a part span variable inlet guide	Tabe of	SIB, A. G. AD-1 oblique wing aircraft program	
TF34 fan performance	vane on	[AIAA PAPER 81-2354]	A82-14390
	N82-12075	SIMON, H.	
SCHUAB, R. W.		Attack on superalloys by chemical and elec-	trolytic
Fuel efficient flight profiles in an ATC f	low	processes	
management environment	A82-13078	CTMON I	A82-14365
SCHUARZ, R. M.	A02-130/0	SIMON, L. A set of finite elements developed for the	dynamic
Strapdown inertial reference systems perfo	rmance	computation of composite helicopter blade	
analysis		[CNERA, TP NO. 1981-87]	A82-13990
	A82-14682	SIMS, R. L.	
SCOUGTON, C. R.		Comparison of wind tunnel and theoretical	
A standard control display unit for multi- application	alfcraft	<pre>aeroelastic predictions with flight measure airloads for the B-1 aircraft</pre>	irea
application	N82-13054	[AIAA PAPER 81-2387]	A82-14393
SEAL, J. J.	202 13031	SINGLEY, G. T., III	102 14333
A modular multiplexed digital voice		Test and evaluation of improved aircrew res	straint
intercommunications system		systems	_
CERRITA R .	A82-14721	ANAT 117 P. A	A82-14974
SEBRING, D. L. Redundancy management of skewed and disper	cod	SKOLNIK, E. G. Chemistry of combustion of fuel-water mixts	TOS
inertial sensors	seu	[AD-A105401]	N82-12178
[AIAA 81-2296]	A82-13503	SKUDRBA, J. T.	202 .2
SEGREST, J. D.		Joint Tactical Microwave Landing System /J:	TMLS/
Computer modeling of an aircraft HVDC elec	trical	airborne signal processing	
system	100 44040	[AIAA 81-2247]	A82-13471
SEIRABIAN, A. P.	A82-14819	SLATER, G. L. Digital control for flexible aircraft using	~
Divergence of a sweptforward wing		reduced order models	9
	A82-13560		A82-13094
SEITLER, J. K.		SLEGEIR, W. A.	
Terrain actuated deployment system		Development of catalytic systems for the	
CRITERS A P	A82-14982	conversion of syngas to jet fuel and dies	sel fuel
SBLLBBS, D. F. Computer simulation of an advanced aircraf	+	and higher alcohols [DE82-000067]	N82-12255
electrical system	•	SMALL, D. H.	NOZ-12233
	A82-14821	The electronic terrain map - A new avionic:	5
SHAH, N. M.		integrator	
Evaluation of advanced air-to-air gunnery	fire	[AIAA 81-2289]	A82-13498
control systems	101 40750	SHEAD, P. W.	L • • • • •
SHANHON, J. H.	A82-14750	The agile transversal filter - A flexible block for ICNIA	Dailaing
Applications of digital avionics to commer	cial	DIOCA INI ICHIA	A82-14765
transport aircraft - The DC-9 Super 80 a		SMITH, G. A.	
	A82-13456	Application of the concept of dynamic trim	
SHAPIRO, B. Y.		and nonlinear system inverses to automat	
The use of observers on relaxed static sta aircraft	Dility	control of a vertical attitude takeoff as	na
aliciali	A82-14740	landing aircraft [AIAA 81-2238]	A82-13466
Enhanced aircraft handling qualities by	ECZ 14740	SMITH, J. M.	BO2 15400
longitudinal dynamics mode decoupling		Effect of vacuum exhaust pressure on the	
	A82-14826	performance of MHD ducts at high D-field	_
SHAULER, W. H.		[NASA-TH-82750]	N82-13908
62% manned aircraft demonstrator - Next ge trainer	neration	SMITE, J. W. Analysis of a longitudinal pilot-induced	
[AIAA PAPER 81-2519]	A82-14385	oscillation experienced on the approach	and
SHERWIN, P.		landing test of the space shuttle	
Group 1: Scenario design and development	issues	[NASA-TH-81366]	N82-13149
	N82-13131	SMITH, L. E.	
SHIBLDS, B. R.	_11_	An update of an integrated CNI system - TI	
P/A-18 Flight Test program overview - 1 Se 1981	ptember	[AIAA 81-2292]	A82-13500
[AIAA PAPEE 81-2351]	A82-13955	SMITH, W. S. KC-10 flight test program	
SHIWAR, J.		no to initial topo program	A82-14935
Comparison between the exact and an approx	imate	SHOLKA, J. E.	
feedback solution for medium range inter	ception	Acceptance testing of the Calspan variable	
problems		stability Learjet	100 44027
SHOWALTER, T. W.	107_4740/		A82-14937
	A82-13106		
Simulator certification methods and the ve		SMITH, B. The role and implementation of different	
Simulator certification methods and the ve motion simulator		SHYTH, B. The role and implementation of different nacelle/engine simulation concepts for	
		The role and implementation of different	lopment
motion simulator [NASA-CR-166252] SHUTT, S. G.	rtical	The role and implementation of different nacelle/engine simulation concepts for	
motion simulator [NASA-CR-166252] SHUTT, S. G. A concept for a high-accuracy, low-cost	rtical	The role and implementation of different nacelle/engine simulation concepts for wind-tunnel testing in research and deversions on transport aircraft	lopment N82-13086
motion simulator [NASA-CR-166252] SHUTT, S. G.	rtical N82-12082	The role and implementation of different nacelle/engine simulation concepts for wind-tunnel testing in research and devework on transport aircraft Pinal report on the FueFo-4 major theme:	
motion simulator [NASA-CR-166252] SHUTT, S. G. A concept for a high-accuracy, low-cost	rtical	The role and implementation of different nacelle/engine simulation concepts for wind-tunnel testing in research and deversions on transport aircraft	

SOBOCIESKI, E.		CHIRCON D T	
Aircraft separation assurance avionics		SVANSON, R. L. A standard control display unit for multi-airc	raft
[AIAA 81-2239]	A82-13467	application	
SOMMER, D. L.			- 13054
Computer modeling of an aircraft HVDC elec	trical	SURET, L. M.	
system	A82-14819	Digital detection and processing of laser beaco	
SORATHIA, U. A. K.	A02-14019	signals for aircraft collision hazard warning [AIAA 81-2328] A82-	g -13525
Pormulation and characterization of polying	ide	SYBERG, J.	13323
resilient foams of various densities for		Performance of highly integrated inlets for	
aircraft seating applications		supersonic aircraft	
[NASA-CR-167421]	N82-12230	N82-	-13066
SPAHE, H. R. Theoretical analysis of wake-induced parace	hnto		
collapse	,nace	T	
[AIAA PAPER 81-1922]	A82-13963	TABB, J. A.	
SPENCER, J. L.		Lockheed Airborne Data System - Distributed	
On-board communication for active-control		microcomputers provide on-board real-time and	
transport aircraft	A82-13520		- 13949
[AIAA 81-2321] SPIEGEL, S. S.	NOZ-13320	TAXABABA, K. An aerodynamic design and the overall stage	
LHX - An advanced avionics system design		performance of an air-cooled axial-flow turb	ine
[AIAA 81-2249]	A82-13472		-13109
STALCHY-DOBEZANSKI, J.		TANG, W.	
Evaluation of advanced air-to-air gunnery	fire	Application of multiple model estimation	
control systems	A82-14750	techniques to a recursive terrain height correlation system	
STARK, D.	802 14730		-14768
Options for GTE precision automated tracki		TAVORA, C. J.	
-	A82-13020	A storage device for subsystem maintenance	
STRIN, A.	43	information	4404-
Experimental investigation of a helmet move sight/display for belicopter	inted	#	- 14817
Signey display for helicopter	N82-13060	TAYLOR, D. K. An analysis of civil aviation propeller-to-pers	รดก
STRIBBETZ, G. G.		accidents: 1965-1979	
Have we overlooked the pilot's role in an		[AD-A105365] N82-	- 12053
automated flight deck	100 40404	THER, D. T.	
[AIAA 81-2262] The integration of control and display con	A82-13481	Analysis of escape systems at 687 KEAS	-14978
for improved pilot situational awareness		THOMA, H.	- 149/0
Tot Total and Later and Aller and Al	A82-13972	Attack on superalloys by chemical and electroly	vtic
STENGEL, R. P.		processes	
Design and flight test of a lateral-direct	ional		- 14365
command augmentation system	101-12527	THOMAS, B. B.	
[AIAA 81-2331] STEVENS, V. C.	A82-13527	Direct strike lightning measurement system [AIAA PAPER 81-2513] A82-	-13910
Powered-lift STOL aircraft shipboard opera	tions -	THOMPSON, W. D.	13310
A comparison of simulation, land-based a		Plight investigations of integrated descent rate	t€
trial results for the QSRA		control systems	
[AIAA PAPER 81-2480]	A82-13938		-14929
STIME, L. R. Advanced integrated CNI architectures		THULLEN, H. J. Advanced wearon systems - Integration technolog	.
Wildhood Intolisted out dicultestates	A82-14763		-13533
STOCKS, C. P.		TILL, B. D.	
The design and development of the Tornado	engine	Instrumentation to determine the suitability of	
air intake	200 40070	RNAV systems for helicopter navigation in the	8
STONE, A. L.	N82-13074	national airspace system /NAS/	-13911
Air-to-ground MTI radar using a displaced	phase	[AIAA PAPER 81-2514] A82- TIMPSON, K. G.	- 13911
center, phased array	£	The F-16/79 test program	
	A82-14881		-13855
STOUDER, D. J.		TKACH, M. J.	
An advanced facility for processing aircra dynamic test data	IIC	F/A-18 roll rate improvement program	- 14939
[AIAA PAPES 81-2398]	A82-14377	TONER, B. G.	17737
STRUCK, E.		Digital detection and processing of laser beaco	מכ
Calculation of wing-body-nacelle interfere	ence in	signals for aircraft collision hazard warning	3
subsonic and transonic potential flow	V02 42005	[0. 2020]	- 13525
STURLPRAGEL, T. B.	พ82-13095	TOOLAN, W. K. Development and laboratory test of an integrate	e d
Public service helicopters - Is the grass	greener	sensory system /ISS/ for advanced aircraft	- 4
on the other side of the fence	•		-13504
	A82-13238	TRACY, H. A.	
SUIT, W. T.	hniana	F-4 Advanced Avionics Flight Test	12020
On matching the systems identification tec to the particular application	untdas	[AIAA PAPER 81-2464] A82- TRAN, C. T.	-13929
	A82-13119	Application of the ONERA dynamic stall model to	эа
SURBER, L.		helicopter blade in forward flight	
Performance of highly integrated inlets for	or	[ONERA, TP NO. 1981-89] A82-	- 13992
supersonic aircraft	N82-13066	TSOUBANOS, C. H.	nontor
SVEC. R. K.	402-13000	The TADS/FNVS 'eyes' for the AH-64 attack helic	-13239
Plight testing the suspended maneuvering s	system	TULLOCH, H. L.	
[AIAA PAPER 81-2498]	A82-13922	The use of metal finishing in aircraft fuel sys	
SWANN, No R.			-12077
Experience with flight test trajectory gui	idance 14379	TUNG, C. Experimental and analytical studios of a model	
Lacon answers, word	-V£ 17J/J	Experimental and analytical studies of a model helicopter rotor in hover	
		[NASA-TH-81232] N82	-12042

WALLIS, T. B.
The Cessna T303 Crusader
[AIAA PAPEE 81-2440]

N82-13116

N82-13150

N82-13097

U		Computational considerations for fusion in identification systems	target
UGRIUMOV, V. S.			A82-14735
Efficient use of working fluids in aviation hydraulic systems USUL, H.	n A82-15724	WANG, S. Y. Effect of vacuum exhaust pressure on the performance of MHD ducts at high D-field [NASA-TM-82750]	N82-13908
An aerodynamic design and the overall stage performance of an air-cooled axial-flow { [NAL-TR-321T]		WARBURTCH, R. B. Advanced exhaust nozzle technology	พ82-13078
(,		BARD, C. B.	
V.D.KOLK, J. T.		New advances in signal processing technologing integrated CNI avionics	gy for A82-14762
Aerodynamic aspects of a high bypass ratio installation on a fuselage afterbody	engine N82-13093	WARD, H. B. AN/TPN-25 and AN/GPN-22 precision approach	
VAN GOOL, H. P. C. Comparison of low-speed handling qualities	1 n	WARUSZEWSKI, H. L. Color CBT displays for the cockpit	N82-13051
ground-based and in-flight simulator tes [AIAA PAPEE 81-2478] VAN PELT, L. G.	A82-13936	WARUSZEWSKI, H. I., JR. Airborne color CRT displays	
<pre>Plight test concept evolution [AIAA PAPEE 81-2375]</pre>	A82-13944	WARWICK, G.	A82-14823
VANENGELES, J. A. J.	B02-13344	Fighters - Improving the breed	
Evaluation of an experimental technique to			A82-14354
investigate the effects of the engine po- on engine/pylon/wing interference	sition N82-13090	PASSON, R. L. The application of large screen CRT's, tou panels, and voice to the flight stations	
VANHENGST, J.		1990's	
Aerodynamic aspects of a high bypass ratio installation on a fuselage afterbody	engine	[AIAA 81-2263] WASSUM, D. L.	A82-13482
VANTUIJL, W. H.	N82-13093	Pressure distributions on three different cruciform aft-tail control surfaces of a	2 70
Orienting description of air traffic contro the Netherlands	OI 1N	wingless missile at Mach 1.60, 2.36, and Volume 1: Trapezoidal tail	3.70.
[VTH-LR-285]	N82-12063	[NASA-TM-80C97]	N82-13110
VARNEY, A. H. Analytical and experimental characterization	on of	WATKINS, J. R. USNTFS spin program	
the JAU-14/A cartridge actuated initiato	r for		A82-14931
use in aircrew escape system performance evaluation	A82-14985	The Maneuvering Flight Path Display - A fl trajectory solution display concept	
VEDOVA, B.	T 3	BAMPD 1 C	A82-14824
Comparison of different nozzle concepts for reheated turbofan	N82-13077	NAURR, J. C. Airplane performance sensitivities to later vertical profiles	
VELLENGA, C. Applications of covariance analysis simula Avionics flight testing	tion to	WBBB, D. B. Further test results of parachutes with au	A82-15846
	A82-14767	inflation modulation /A.I.M./	
VIETS, H. Investigation of acoustic interactions in thrust augmenting ejectors	jet	WBBB, L. D. Recent propulsion system flight tests at t.	A82-14965 he NASA
[AD-A106083] VILENKIH, A. V.	N82-13835	Dryden Flight Research Center [AIAA PAPER 81-2438]	A82-13874
Optimization of requirements on the pitting-prevention properties of turboje	t-engine	WEBB, R. C. 60 kVA ADP permanent magnet VSCF starter g	
oils	A82-15723	system - A program overview	A82-14789
VINCENT, J. B.		WEBB, S. G.	
Integrated flight testing based on nonline system identification data processing te [AIAA PAPER 81-2449]		Digital detection and processing of laser signals for aircraft collision hazard was [AIAA 81-2328]	
VOGE, V. B. 'Little people' problem /MA-2 torso barnes:		WEBBR, J. W. Airborne Electronic Terrain bap System	A82-14771
VOLODEO, A. H. Safety of helicopters in flight	A82-14958	WBBES, B. A. Avionics systems simulation for the Northr	
VOOGT, H.	A82-14946	F/A-18L aircraft [AIAA 81-2274]	A82-13488
Aerodynamic aspects of a high bypass ratio installation on a fuselage afterbody	-	WRINGARTEN, N. C. Comparison of low-speed handling qualities	1.0
***	N82-13093	ground-based and in-flight simulator tes [AIAA PAPER 81-2478] WEINREICE, B. L.	ts A82-13936
W		Final report on the FueFo-4 major theme:	
WALKER, B. L. Design study report for General Aviation L. receiver	oran-C	Interference drag with airframe/engine integration on fighter aircraft [BMVG-PBWT-79-20]	N82-13116
[AD-A104921]	N82-12062	WEISSHAR, T. A.	
WALLEMBEEG, R. Inverse SAB and its application to aircraf classification	t	Interactive aircraft flight control and aeroelastic stabilization [NASA-CR-165036]	ม82 - 13150
UNITE # P	A82-14871	WELGE, H. R. Prop-fan integration at cruise speeds	

A82-13876

Prop-fan integration at cruise speeds

YAHAHOTO, A.

WELL, K. H. Comparison between the exact and an approx feedback sclution for medium range inter problems	
WELBER, V. H.	A82-13106
The TADS/PNVS *eyes* for the AH-64 attack	helicopter A82-13239
WELTE, D. Wing design for light transport aircraft w improved fuel economy	ith
WESTERMEIBE, T. P.	A82-14416
Parallel processing applied to digital flu	ght
control systems - Some perspectives	182-14794
WEWERIBER, P. H. The effect of visual information on manual	
approach and landing [NLB-MP-80019-U]	N82-12064
Navy spin evaluation of the A-7 airplane	
configured with automatic maneuvering fl	.aps A82-14933
WHITE, T. D. Measured pavement response to transient ai	rcraft
loadings	N82-13442
WHITEFIELD, J. D.	
Overview of flight and ground testing with emphasis on the wind tunnel	1
[AIAA PAPEE 81-2474] WHITTON, I. J.	A82-13928
An integrated control panel utilizing a	_
programmable varistor-multiplexed dichro	oic
[AĪAA 81-2303] WILLIAMS, D. H., JR.	A82-13508
Testing capabilities of the 3246th Test Wi	ng A82-14387
Effects of intake geometry on circular put	ot
intake performance at zero and low forwa	
WILSON, D. H. A polled contention multiplex system using MIL-STD-1553 protocol	Ī
[AIAA 81-2271]	A82-13487
WILSON, R. J. Flight test experience with high-alpha con	trol
system techniques on the F-14 airplane [AIAA PAPER 81-2505]	A82-13906
FING, R. G.	
The protection of gas turbine blades - A particular aluminide diffusion coating	
WOLF, D. P.	A82-14364
Theoretical analysis of wake-induced parac collapse	hute
[AIAA PAPEE 81-1922] WOLF, T. D.	A82-13963
Experience with flight test trajectory gui	idance A82-14379
BONG, E. Y. Digital detection and processing of laser	beacon
signals for aircraft collision bazard wa [AIAA 81-2328]	A82-13525
Passive terrain following using stored map	and
global positioning system	A82-14772
Thrust modulation methods for a subscnic V	//STOL
aircraft [NASA-TM-82747]	N82-13112
WYGLE, B. S. Two at a time - Flight test plans for the	
Boeing airliners [AIAA PAPEE 81-2378]	A82-13941
V	
The state of the s	

An aerodynamic design and the overall stage

performance of an air-cooled axial-flow turbine [NAL-TB-321T] N82-13

YABIV, O. A synthesis technique for highly uncertain and interacting multivariable flight control systems Wind-tunnel investigation of the effects of blade tip geometry on the interaction of torsional loads and performance for an articulated helicopter rotor [NASA-TP-1926] YBRMIA, M. A numerical method for studying nacelle-jet-airfoil interaction in inviscid three-dimensional flow N82-13094 YOUN, H. H. High speed PMG containment study for VSCF system A82-14791 YOUNG, J. T. Redundancy management of skewed and dispersed inertial sensors [AIAA 81-2296] 182-13503 NOUNG, W. L., JE.
Integrated Flight/Weapon Control design and evaluation A82-14741 YURCZYK, B. F. Analysis of escape systems at 687 KEAS A82-14978 Wind tunnel tests of ejection seat for high dynamic pressure escape A82-14979 Z ZALESAK, P. F., SB.

Flight testing the nonmetallic spline coupling technology at the Naval Air Test Center [AIAA PAPER 81-2405] A82-13891 ZAMAN, M. K. Fiber-optic immunity to EMI/EMP for military aircraft [AIAA 81-2339] A82-13529 ZEIDLER, V. Performance assessment of an advanced reheated turbo fan engine [AIAA PAPER 81-2447] A82-13879 ZIBGBBBAGBN, J. A. Pailure analysis of variable reluctance stepper motor

> Development and laboratory test of an integrated sensory system /ISS/ for advanced aircraft [AIAA 81-2297]

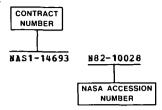
A82-14792

CONTRACT NUMBER INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Suppl. 146)

MARCH 1982

Typical Contract Number Index Listing



Listings in this index are arranged alphanumerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order with the IAA accession numbers appearing first. The accession number denotes the number by which the citation is identified in either the IAA or STAR section.

AF PROJ. 2003	F33615-79-C-3406
N82-13135	A82-14978
AF PROJ. 2301	F33615-79-C-3604
N82-12081	A82-14741
AF PROJ. 2401	F33615-79-C-3618
N82-12143	A82-13936
AF-AFOSR-78-3633	A82-13968
A82-15845	F33615-80-C-1095
AF-AFOSR-80-0213	A82-14817
A82-14827	F33615-80-C-2004
AF-AFOSR-0178-80	A82-14788
N82-12081	F33615-80-C-2032
DA PRQJ. 1L1-62209-AH-76	
· · · · · · · · · · · · · · · · · · ·	A82-14791
N82-12057	F33615-80-C-3217
DA PROJ. 1L2-62202-AH-85	A82-13122
N82-12067	F33657-78-C-0490
DA PROJ. 1L2-62209-AH-76	A82-14780
N82-13107	F49620-77-C-0023
DAAK51-79-C-0009	N82-13979
N82-1205/	F49620-79-C-0038
N82-12057 DAAK80-79-C-0268	A82-13093
A82-14768	F49620-81-C-0026
DAAK 80-79-C-0270	A82-14829
N82-12067	MDA903-79-C-0320
N82-13141	N82-13136
DE-AC01-80CS-50141	NAG1-80 N82-12080
N82-13014	NAG1-157 N82-13150
DE-ACQ2-76CH-00016	NAS1-14623 N82-13098
N82-12255	NAS1-14908 N82-12051
DE-AI01-77ET-10769	NAS1-15051 N82-12065
N82-13908	NAS1-15304 N82-12142
DOT-FA79NA-6030	NAS1-15359 A82-13520
N82-12061	NAS1-15428 A82-13490
DT-FA01-80-C-10108	NAS1-15884 N82-12052
N82-12062	NAS1-16414 A82-13508
PAA PROJ. 045-390-130	NAS2-9741 N82-12082
พ82-12059	NAS2-10100 N82-13096
FAA - PROJ = - 131-402-854	NAS3-21624- N82-12075
N82-12304	NAS3-22481 N82-13145
PAA PROJ. 999-113-000	NAS4-2571 N82-12079
N82-12056	NAS9-16009 N82-12230
P04701-80-C-0081	NCC2-93 A82-13534
A82-13956	NCC2-94 A82-13525
P09603-79-C-1610	NGL-05-020-243
A82-14778	N82-13147
F33615-73-C-4036	NGL-31-001-252
A82-14696	A82-13525
P33615-74-C-2037	NGR-36-009-017
A82-14789	A82-13532
P33615-77-C-3096	NSF SES-79-10397
A82-13122	A82-14793
F33615-78-C-1563	NSG-1083 A82-13878
A82-13142	NSG-1496 A82-13107
A82-14684	NSG-2156 A82-13534
P33615-78-C-1583	NSG-2165 N82-13186
A82-14696	N00014-77-C-0032
F33615-78-C-2200	A82-15835
A82-14789	N00014-78-C-0257
P33615-78-C-3145	A82-13527
A82-13470	N00014-78-C-0641
F33615-78-C-3218	A82-14389
N82-12143	N00014-79-C-0424
F33615-79-C-0508	A82-15845
A82-14744	N00014-80-C-0534
F33615-79-C-1878	N82-12178
N82-13135	1

N00019-79-C-0225 N82-13835 N00164-79-M-2522 N82-12248 N62269-79-C-0206 A82-13504 N62269-79-V-0265 A82-14819 505-11-23-03 N82-13110 505-32-12 505-32-32 N82-13146 N82-13143 505-32-93-01 N82-13142 505-33-53-01 N82-12041 505-42-13-04 N82-13107 505-43-13-01 N82-13148 505-43-14 N82-13149 505-44-13-01 N82-12052 506-51-13-02 N82-13106 512-54-14 N82-12079 778-11-05 N82-13908 922-21-01 N82-12042

1. Report No. NASA SP-7037 (146)	2. Government Access	sion No.	3. Recipient's Catalog	No.
4. Title and Subtitle			5. Report Date March	1982
AERONAUTICAL ENGINEERING			6. Performing Organiz	
A Continuing Bibliography (Supplement 146)		6. Performing Organiz	ation wde
7. Author(s)			8. Performing Organiz	ation Report No.
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